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THE NEW DIETETICS

WHAT TO EAT AND HOW

A Guide to Scientific Feeding
in Health and Disease

By JOHN HARVEY KELLOGG
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The New Dietetics

DEDICATED

To the memory of my dear wife, whose faithful co-operation and indefatigable labors during more than forty years of continuous and harmonious effort in various activities directed toward race betterment, contributed in a large measure to whatever of real accomplishment our combined efforts may have achieved.

JOHN HARVEY KELLOGG

PREFACE

Within twenty years a new science of dietetics has been developed. As the result of the patient labors of many men, numerous mysteries have been cleared up, many hoary-headed theories have been exploded, and a great flood of light has been thrown upon one of the most important questions related to human existence.

It is now possible to say with a considerable degree of certainty how much food is needed daily by a man, woman or child at rest or at work, and to indicate what particular foodstuffs are best suited to meet any dietetic need which may be indicated in any condition of health or disease. It is also possible to state with reference to every common foodstuff what is its value as a source of energy and what its special dietary properties and characteristics.

In other words, there now exists a real science of dietetics based on scientific facts worked out in laboratory researches, verified by animal feeding experiments and confirmed by clinical experience. Dietetics is no longer the jumbled mass of empirical notions of which it largely consisted even so late as two decades ago.

Thanks to the painstaking researches of Pavlov, Rubner, Atwater, Benedict, Chittenden, Mendel, Osborne, McCollum and other investigators perhaps equally worthy of mention, we now possess knowledge instead of assumptions, facts instead of fancies, scientific standards in place of empirical though time-honored notions and sanctions.

There is perhaps no place in the world where the successive steps of scientific progress in the knowledge of nutrition and dietetics have been watched with greater care and interest than at the Battle Creek Sanitarium. For more than forty years this institution has been a great clinical laboratory in which an intensive study of foodstuffs and of their effects upon the human body has been continuously carried on by the writer and his associates. As new discoveries have been made in the nutrition laboratories of this country and Europe, the results have been carefully scrutinized and tested in actual clinical practice. It is not claimed that complete knowledge has yet been attained. There is still much to be learned about human nutrition, and

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the rapid progress which is being made in these days affords good foundation for the hope that the advances within the next few years will be fully equal to those made in the past.

In the preparation of this work the author has made use of all available, well attested facts to be found in the authoritative works on human nutrition, and has added thereto the results of nearly a half century's careful study of the subject, theoretically, clinically and experimentally. As editor of "Good Health" since 1873 and Medical Director of the Battle Creek Sanitarium since 1876, the writer has been in constant contact with men and women enquiring the way to health, and has devoted his life in large measure to finding the correct answers to the questions, What is the biologic way in eating? How may each particular foodstuff be best utilized as a means of promoting the cure of disease? and similar queries.

So far as the writer knows, this is the first work in which full recognition has been accorded the important discoveries of Bouchard, Metchnikoff, Tissier, and others in relation to the influence of diet upon the intestinal flora through the effect upon the food residues which form the nutrient media for the various organisms, benign and pernicious, which by various means find their way into the human alimentary canal.

In this work a conscientious attempt has been made to set forth only such recommendations as have a solid basis of physiologic fact verified by actual practical experience.

The constant aim of the author has been to present the known facts relating to human nutrition in such a way as to be of greatest service to the physician, the trained nurse, the intelligent housewife, and to every student of nutrition, as well as to the professional dietitian. To this end numerous tables have been prepared by the use of which the dietary may be balanced not only for protein, fats and carbohydrates, but also for cellulose, lime and iron, and even acids and bases. These tables are based upon the data supplied by the tables of Atwater, Bunge, Gautier, Koenig, and Sherman. They have been in constant use at the Battle Creek Sanitarium and elsewhere for several years.

The writer especially desires to acknowledge his indebtedness to a large number of colleagues and assistants who during the last forty-five years have co-operated in his efforts to solve dietetic problems of various sorts, the solution of some of which have resulted in the production of some of the most popular of the present day breakfast foods. First of all I am indebted to my dear wife, Mrs. E. E. Kellogg, recently deceased, for most faithful co-operation during many years in the experimental work which resulted in the establishment of the dietary system of the Battle Creek Sanitarium.

To Miss Lenna Cooper, Dean of the Battle Creek Sanitarium School of Home Economics, I am indebted for great assistance in perfecting and systematizing the dietary methods and improving the cuisine upon which the practical suggestions of this book are based.

To Professor Irving Fisher is due credit for first proposing the plan of "food portions" consisting of quantities of food representing 100 calories of energy or a simple fraction of this amount.

To his sister, Mrs. Clara K. Butler, and to Miss Gertrude Estill, the author is much indebted for most efficient and indispensable assistance extending over many months in compiling a great mass of notes and memoranda accumulated during many years, and painstaking supervision of copy and proof sheets while going through the press.

I desire, also, to express my appreciation of the courtesy of Robert Smith, Ph. D., of the Sheffield Scientific School of Yale University, in giving the proof sheets of the work a careful reading.

Finally, in presenting this work to the public as the result of a life time study of dietetics from the standpoint of a physician and a believer in Nature as the wisest of all teachers, the writer desires to ask the reader's consideration of the fact that however widely the ideas and methods herein presented may differ from those current in popular and professional usage, they cannot be justly looked upon as simply theoretical or experimental, since they are in daily and successful practical use in a large institution, in the development of which during the last forty-five years they are believed to have been the most important factor. However novel the methods presented may seem to some readers, they are by no means new; they are based upon biologic principles which are as old as the human race and only need a fair trial to demonstrate their value. That the candid reader will accord the views presented the test of actual practical experience with open mindedness and in the spirit of scientific inquiry, is the earnest hope of the writer.

January, 1921. John Harvey Kellogg.

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The New Dietetics

FOODS

Any substance to be properly regarded as human food must be capable of supplying the body with the material needed for the repair of its tissues and to maintain its various functions, while at the same time working no injury to the body and in no way interfering with its activities. There are many substances which possess some of the properties of foods and might be useful nutrients except for the fact that they contain special substances which are inimical to the interests of the body, and hence are injurious. There are, in fact, numerous organic compounds, products of the vegetable kingdom, which are not only incapable of sustaining the life of human beings but prove rapidly destructive. Such substances are not foods but poisons. Alcohol, for example, though oxidized or burned in the body as is starch and sugar, is not to be regarded as a food for the reason that it possesses toxic properties which render its use unsafe.

Food as Fuel.

Life has been likened to a consuming fire—a flame. One of the chief functions of food is to serve as fuel by the burning of which the animal heat is maintained, and the energy required for every sort of bodily activity is supplied.

The wastes dismissed from the body through the bowels and the kidneys represent the smoke and the ashes which result from vital combustion, which is not simply a burning *in* the body, but actual destruction or burning *of* the body.

The vital combustion which constitutes life differs from the fire which burns in a stove or a furnace, not only in the fact that it burns without a luminous flame and in the presence of water, which is fatal to an ordinary fire, but in the fact that in the case of the stove or furnace, the container does not itself burn, having such properties as enable it to resist the action of fire; whereas, in the case of the combustion within the bodies of human beings and animals, the body itself, the container as well as the fuel, is slowly consumed, as would be the case with a stove or a furnace constructed of wood. Indeed, it is even possible that the iron walls of a stove itself may be in time destroyed. Iron will rust if long exposed to air and moisture, and this rusting is a sort of burning akin to the combustions which occur within the body through the agency of the oxygen of the air.

Burning is oxidation. When the oxidation takes place rapidly, the burning is accompanied by a flame and intense heat. If the process is sufficiently slowed down, there is no flame and the heat is moderate in intensity, although the total amount of heat produced by the burning or oxidation of any substance is exactly the same whether the burning is rapid and accompanied by a flame or so slow that no rise of temperature is perceptible to the senses.

That the body is not destroyed by vital combustion is due to the fact that the tissues are continually reproduced or recreated from new material furnished in the form of food.

Food thus supplies material for repair of the living machinery of the body, as well as fuel to keep the body warm and energy for muscular work and other forms of vital activity. Food is also a stimulant to the body cells. Many so-called stimulant drugs, such as alcohol, are, in fact, not stimulants, but narcotics. They paralyze the living cells and lower their working efficiency. They waste and do not replenish the energy of the body. Wholesome food is a normal and useful cell stimulant. Drug stimulants are unnatural and harmful.

The Chemical Composition of the Body.

By an examination of the smoke and ashes resulting from the burning of a house or an animal, it may be possible to determine the nature of the elements which entered into its structure. That is, an examination of the ashes of a burned house will show how much iron, lime, and other minerals existed in the house before it burned. Investigations made in relation to the chemical composition of the body have shown it to be as follows:

TABLE I.

Showing the Chemical Composition of the Adult Human Body.

	Per cent	In a man weighing 150 lbs.	
Oxygen	65	97.5	lbs.
Carbon	18	27.0	”
Hydrogen	10	15.0	”
Nitrogen	3	4.5	”
Calcium	2	3.0	”
Phosphorus	1	1.5	”
Potassium	0.35	8.4	oz.
Sulphur	0.25	6.0	”
Sodium Chlorid	0.15	3.6	”
Magnesium	0.05	1.2	”
Iron	0.004	.1	”
Iodine	Minute quantities		
Fluorine			
Silicon			
Zinc			

Oxygen is obtained chiefly from the air, but also from the food.

Hydrogen is one of the constituents of water and is found in nearly all foods.

Nitrogen is obtainable only from the proteins of the food. The air is four-fifths nitrogen, but atmospheric nitrogen can be used by the body only after it has first been assimilated by plants under the influence of the sunlight.

Carbon is obtained chiefly from starch and sugar. Carbon is also obtained from fats in which it is found in combination with much hydrogen and a little oxygen, and in small amount from protein.

Iron and lime and other salts are chiefly found associated with protein. They are most abundant in the bran or outer coats of seeds and in the green parts of plants,—leaves and tender shoots and in milk and the yolk of eggs.

The amount of iodine found in the body is very small, yet this minute amount appears to be essential for the function of the thyroid gland, in the secretion of which it is found.

Recent researches have shown that the metal zinc is a constant constituent of the tissues and of foodstuffs and in about the same proportion as iron. The total amount of zinc in the body of a man weighing 150 pounds is about 30 grains.

The most important mineral constituents of the body from a dietetic standpoint are potash, soda, lime and iron. The magnesia and other mineral substances which enter into the composition of the body are so closely associated with the lime and iron that if care is taken to see that the food contains a sufficient amount of these elements, there is scarcely a probability that any of the essential food salts will be found lacking.

Differences in the Composition of the Body in Infants and Adults.

According to the *Chemiker-Zeitung,* the following marked differences have been found in the composition of the bodies of children and adults:

The water-content of a new-born infant is about 75 per cent of its body weight; that of an adult 58 per cent. The muscles of an adult are 77 per cent water. Growing infants need considerable quantities of water. An infant needs to take daily in some form, about one-seventh its weight of water. Most of this is absorbed from its food. An adult requires daily about one-thirtieth his body weight of water in food and drink.

The amount of water is determined somewhat by the kind of food eaten. When considerable protein is taken, much water is required to carry off through the kidneys the urea and other waste products resulting from its metabolism. Carbohydrates. that is, starch and sugar, require the retention in the body of three times their weight of water, while retained salt requires more than 100 times its own weight of water.

The cartilages of an infant contain 2.24 per cent of lime; the bones of a person 19 years of age contain more than three times as much.

The blood of an infant contains a much larger number of white blood cells than does that of an adult.

Between infancy and the attainment of adult size there is a notable change in the relative size of various organs. The brain of an adult is 4 times as large as the infant brain. The adult liver is 11 times as large, the heart 12 to 13, and the lungs 20 times as great as that of the infant.

The Source of Food.

For all the thousands of various substances which are capable of sustaining animal life we are indebted to the sun. The energy of the sunlight, captured by the mysterious alchemy of the chlorophyl grains found in green leaves, is the source of all human energy as well as of the energy displayed in the manifold activities of animal life in its varied forms. Indeed, almost every form of energy with which we are acquainted is derived from the sun. It is sunlight in modified form which turns all the windmills and water wheels and the machinery which they drive. It is the energy derived from coal and petroleum (fossil sunlight) which propels our steam and gas engines, our locomotives and automobiles. The chlorophyl grains of the green leaf capture the rays of light as they flit by at the rate of 186,000 miles a second, and with this magic force, bind together the atoms which form the so-called organic molecules, and endow with the mysterious properties of living matter the lifeless particles of hydrogen, oxygen, iron, lime and other chemical elements which enter into the composition of animal and vegetable structures.

Food is simply sunlight in cold storage. The function of the plant is to store the energy borrowed from the sun, preparing it for the service of man and animals that, like the steam engine, the furnace or the lamp, must be regarded as mechanisms for using or expending energy. The heat which glows in the fire on the hearth, the light which shines out from the incandescent lamp or the brilliant electric arc, are nothing more than resuscitated sunlight; so likewise the heat of our bodies and the energy of mind and muscle which we are able to display, are transmuted sunshine.

Food Principles

The many thousands of different substances which may serve as food for human beings and for animals, notwithstanding the enormous differences in appearance, flavor and other qualities, are made up essentially of six simple kinds of materials. These are:

1. Proteins.
2. Carbohydrates.
3. Fats.
4. Salts or food minerals.
5. Vitamins.
6. Cellulose.

It is necessary to understand the chief facts relating to these several food principles in order to have any proper understanding of scientific dietetics.

Proteins.

The proteins, or albuminous substances, contain in addition to the carbon, hydrogen and oxygen of the carbohydrates, nitrogen and sometimes also sulphur or phosphorus and iron. The protein molecule is very large, having a molecular weight from 500 to 1,000 times that of water.

As known to the chemist, proteins are the dead remains of the protoplasm or living substance of plants and animals. Proteins are produced by plants. They cannot be produced by the chemist, and the tissues of animals are able only to slightly modify the proteins which plants produce.

Protein supplies the body with the nitrogen, sulphur and phosphorus which, with hydrogen, oxygen and carbon, are the chief chemical elements which enter into the composition of the living structures of the body, the nerves, muscles, glands and other parts which constitute the vital machine. Associated with the protein in all animal structures are to be found iron, lime and other mineral elements, some of which are known to form part of the protein molecule. The white of egg, the lean of meat, the curd of milk and the gluten of wheat are examples of protein.

Proteins generally contain sulphur, but some do not contain phosphorus. The offensive odors arising from the burning of protein is due to the poisonous compounds which are formed from nitrogen and sulphur. Compounds of these substances formed either in the chemical laboratory or in the mysterious laboratory of the plant are among the most poisonous known to man. Nitrogen is an essential constituent of the high explosives used in warfare. It enters into the venoms of snakes and the virulent poisons produced by bacteria.

Proteins are not so simple in their composition as are other food principles. The protein molecule is, indeed, very complex. It is made up of a considerable number of substances loosely held together by the energy derived from the sun. These simpler bodies or "building stones" which, in a pure state, appear in a crystalline form, are known to the chemist as amino acids. There are known more than forty of these amino acids. Of these, only eighteen enter into the composition of the human body.

Vegetable proteins differ very greatly in their composition. There are found in the vegetable proteins a considerable number of amino acids which do not enter into the composition of the human body and hence cannot be utilized for tissue building. The number of these "building stones" which enter into the various vegetable proteins differs widely, as well as the proportions in which the different ones are found.

Complete Proteins.

Every plant produces its own variety of protein, and hence there are almost as many kinds of proteins as there are different sorts of plants, for protein is as essential to plant life as to the life of animals. A complete protein, that is, a protein which is alone capable of supplying material out of which the body tissues may be built, is known as a "complete" protein.

Most plant proteins are lacking in some one or more of the "building stones" which are absolutely essential to support growth or repair of the living tissues. It is interesting to note that those foodstuffs which have become staple articles of diet throughout the world are the ones which contain the highest quality of protein. Rice, millet, and the potato owe their popularity, in large part at least, to the fact that they furnish an excellent quality of protein. Among the few vegetable products which furnish proteins which are complete, may be mentioned nuts of various sorts. The soy bean is also notable in this respect. It is particularly interesting to note that while the soy bean furnishes a complete protein, that is, a protein one hundred per cent of which may be utilized in tissue building, the proteins of ordinary peas and beans are worth for tissue building much less than their face value.

The researches of Osborne, Mendel and others indicate that proteins to be able to support growth must contain lysin, an amino-acid which the body is unable to produce. This essential element was found in different proteins in the following proportions:

Casein (cow's milk).....	7.61	"	"
Halibut muscle..........	7.45	per	cent.
Ox muscle..............	7.59	"	"
Vitellin (egg yolk).......	4.81	"	"
Albumin (hen's egg).....	3.76	"	"
Legumin (pea)..........	4.98	"	"
Phaseolin (kidney bean)..	4.68	"	"
Glutelin (maize)........	2.93	"	"
Glutenin (wheat)........	1.92	"	"
Edestin (hemp seed).....	1.65	"	"
Gliadin (wheat).........	.16	"	"
Amandin (almond).....	.72	"	"
Hordein (barley)......	0.00	"	"
Zein (maize)..........	0.00	"	"

It is interesting to note that those proteins which are biologically intended to promote the growth of very young animals, such as milk and egg proteins, are rich in lysin which is essential for the formation of animal proteins.

A person who undertakes to live upon a low protein or nonflesh diet must take care to make such a selection of foodstuffs as will furnish a full supply of complete protein; otherwise the body will languish. Lack of energy, and low resistance to disease are the natural result of a deficient supply of complete protein. Ignorance of this fact or neglect to consider it in arranging bills of fare has been the cause of numberless failures in attempts to dispense with the use of flesh foods. Lean meat furnishes complete proteins, which fact is probably one of the chief reasons for its use as a foodstuff. It is important to remember, however, that the proteins of milk and eggs are equally as complete as meat proteins.

A Poisonous Nucleus in Proteins—Anaphylaxis.

It is now known that every protein molecule contains a group of atoms which under some circumstances may act as a poison. When protein is digested in the normal way and broken up into its "building stones," this poison nucleus is destroyed; but when the proteins are introduced directly into the blood, the breaking up of the molecule is incomplete and the poison nucleus is set free, and highly toxic effects are produced. These effects are known as *anaphylaxis*. They are seen in persons who have been sensitized to certain forms of protein, as in strawberry poisoning, buckwheat poisoning, poisoning from the use of oysters, eggs, shellfish, and various other foodstuffs. Hay fever, or *pollinosis,* is due to the absorption of pollen protein through the mucous membrane of the nose. More will be said further on with reference to sensitization to various foodstuffs.

Carbohydrates.

Carbohydrates are food principles composed wholly of carbon, hydrogen, and oxygen. The hydrogen and oxygen are present in the proportions to form water. There are many different carbohydrates. Those which the body can make use of as food are starch, dextrin, sugar, and fruit acids. The utilizable sugars are cane sugar, malt sugar, milk sugar, dextrose and levulose.

Starch is the most abundant of all the carbohydrates, being found in all cereals, in unripe fruits and a few ripened fruits, in certain nuts and in most vegetables.

Dextrin is derived from starch and is practically identical with it in chemical composition. Sugars are also derived from starch.

There are many different kinds of starches. Each plant produces its own variety of starch, the form of which is so characteristic that it may be used as a means of identification.

Of the various organic vegetable acids, the only ones which are utilized by the body are citric acid, malic acid and tartaric acid. The last named is less fully utilized than the others. Oxalic acid, benzoic acid and some other acids of vegetable origin are not to any extent oxidized or broken up in the body. As found in vegetable foods organic acids are in combination with soda or potash in the form of acid salts. When the acids are burned or utilized in the body, the alkaline soda or potash is left behind; so that the ultimate effect of the utilizable organic acids when eaten is to increase the alkalinity of the vital fluids and not to acidify the body fluids, as was formerly supposed to be the case.

Carbohydrates are almost exclusively derived from vegetable sources.

Glycogen is an animal starch produced by the liver of animals from sugar brought to the liver in the portal vein after absorption from the stomach and intestines. The body of a full-sized man contains about two pounds of glycogen, which is stored in the liver and the muscles. It is converted into sugar as needed for use as fuel, which is its sole function in the body.

Milk sugar is another carbohydrate peculiar to animals, being exceedingly rare in the vegetable kingdom.

The carbohydrates are used in the body to maintain animal heat and to supply energy for work. Every muscular contraction, every heart beat, every bodily movement of any sort involves the burning or destruction of carbohydrate.

If more carbohydrate is eaten than is required for immediate use, it may be stored in the form of fat, a residual tissue which is intended to be drawn upon when the food supply is cut off or reduced.

Every protein molecule contains a carbohydrate group; and when protein is broken up in the body about half its weight becomes carbohydrate and is thus utilized by the body like sugar or starch, the remainder being for the most part excreted as urea.

The human constitution seems to be adapted to a dietary very rich in carbohydrates. A well-balanced bill of fare will contain more than half, at least three-fifths, of its energy value in the form of carbohydrates. Energy in this form is apparently more readily and easily utilized than in any other form. Sugar, in other words, is the natural fuel of the body.

The natives of the Arctic regions, who are compelled to live on a diet consisting almost exclusively of flesh foods, have an intense craving for sweets. In the short summer season these unfortunate people gather as large a store as possible of berries, leaves, and every edible thing of a vegetable character which the soil of that region produces. Shackleton mentions the intense craving experienced by his men for puddings and other dishes prepared from flour during their first long winter night in the Antarctic. The Laplander kills the reindeer after it has eaten a hearty meal of reindeer moss, and regales himself upon the half-digested moss which he removes from the animal's stomach. The Eskimo swallows greedily, doubtless for its vegetable contents, the small intestine of the ptarmigan, a vegetable-feeding bird, as an American gourmand swallows a raw oyster.

These facts agree with the observations of modern physiologists that carbohydrates, to the amount of two or three ounces daily, are absolutely essential to the maintenance of good health, for the reason that the utilization of fats requires the presence of carbohydrates. As Naunyn says, "Fats burn in a fire of carbohydrates." A deficiency of carbohydrate soon causes acidoses.

Fats.

Fats are derived from both animal and vegetable sources. They consist chiefly of carbon and hydrogen, with a small amount of oxygen. Every animal produces a fat peculiar to itself. Such fat is formed by the conversion of starch and other carbohydrates into fat by the action of the body cells.

When fat is eaten, it is deposited in the tissues in essentially the same form as that in which it is swallowed; that is, if hog fat, or lard, is eaten by man it is not transformed into the same sort of fat which the body forms from starch and sugar, but chiefly remains lard, and is deposited in the tissues as lard. The same is true of beef or mutton tallow and of other fats. A dog fed upon mutton fat becomes round and hard like a sheep and is known in the laboratory as "a mutton dog." It is an interesting fact that vegetable fats and oils are more nearly like the natural fat which the body produces from starch and sugar than are the fats found in the ox, the sheep and the hog.

It is generally believed that a certain amount of fat in the diet is essential for the maintenance of health; but Hindhede, the eminent Danish physiologist, has shown in recent years that a man may live in perfect health and sustain his strength for many months on a diet from which fat is excluded.

Hindhede's research seems to show conclusively that fat is not so essential as an article of food as it has heretofore been supposed to be. This is the natural result of the fact that the body is able to make its own fat from starch and other carbohydrates. Another fact of great interest has an important bearing upon this point. A subtle element, the growth-promoting vitamin, essential for health as well as development, is often, though not always, associated with fats. When the fat is lacking or deficient in quantity, this element is likely also to be lacking, and because of this association, which has only recently come to be understood, injuries resulting from the withholding of fats have very naturally been attributed to lack of the fat itself rather than to the absence or deficiency of the growth-promoting vitamin with which the older physiologists were not acquainted. This element is abundant in butter but is deficient in lard, in some vegetable oils and many other fats. It is also plentiful in greens, which Hindhede found an essential part of his bread and potato diet.

Fats, if not absolutely essential, are a wholesome and useful constituent of the dietary. More than any other food, they produce the sense of satiety or satisfaction after eating. They are the most concentrated of all forms of foodstuffs, having an energy value more than double that of either carbohydrates or proteins. If eaten in excess, fats usually produce a rapid gain in flesh, encouraging intestinal putrefaction, with rancid stools, and are apt to give rise to a troublesome and even dangerous condition known as acidosis. It is strictly physiologic that fats be eaten with cereals or breadstuffs, for the starch which is found abundantly in cereals, as has already been shown, is necessary for the proper utilization of fats by the body cells.

Food Salts.

Eight mineral elements, viz., calcium, sodium, potassium, magnesium, iron, phosphorus, sulphur, and chlorine, constitute about four per cent of the weight of the body, or about five or six pounds in a person of ordinary weight. These so-called minerals or mineral salts, are not for the most part, found to any extent either in the body or in foodstuffs in a strictly inorganic-state. It is true that chlorin and sodium in the form of sodium chlorid or common salt, and phosphorus in the form of phosphate of lime, are found in small amounts in foods in an inorganic state; but iron, sulphur, phosphorus and calcium, in general, exist in the body only in organic form. The presence of iron in its ordinary metallic state may be easily recognized by the application of several chemical tests. But organic iron, that is, food iron and the iron of the tissues, cannot be detected by any of these tests, showing that in the chemistry of the plant some subtle change is effected which gives to the so-called mineral elements of the food properties which in their inorganic state they do not possess—in other words, prepares them for use by animals as food.

The body loses daily in the excretions from two-thirds of an ounce to an ounce of salts,—chlorids, sulphates, phosphates and other salts of calcium, magnesium, sodium and potassium. To make good this loss, the daily food must contain at least an equal amount of organic or food salts. This subject will be more fully discussed, together with the method of balancing the diet for food salts, in later chapters.

The Digestive Processes

A complete account of the chemical changes which take place in foodstuffs in passing through the alimentary canal would require the space of a large volume. The essentials of the whole subject may, however, be condensed into a brief space. Here is the subject in a nutshell:

There are practically *four digestible foodstuffs,*—starch, albumin or protein, fats and sugar.

There are *five food laboratories,*—the mouth, the stomach, the small intestine, the colon, and the liver.

There are *five digestive fluids,*—the saliva, the gastric juice, the bile, the pancreatic juice, and the intestinal juice.

The saliva digests starch.

The gastric juice digests protein.

The bile digests fats.

The pancreatic juice digests starch, protein and fats.

The intestinal juice digests all foodstuffs.

Starch is digested by the saliva, the pancreatic juice and the intestinal juice.

Protein is digested by the gastric juice, the pancreatic juice and the intestinal juice.

Fats are digested by the bile, the pancreatic juice and the intestinal juice.

Sugars are digested by the intestinal juice.

The "salts" are dissolved by the several digestive fluids.

Mouth Digestion.

The mouth is a mill. It grinds the food by a gradual reduction process, while it is at the same time being macerated or softened and mixed with the saliva. But the reduction of the food to the consistency of a soft paste is but a small part of what happens in the mouth laboratory. The chewing of the food sets in operation the whole series of food laboratories. When the movements of the jaw begin, the salivary glands start to pour out the saliva, the gastric glands secrete gastric juice, and all the other laboratories prepare for the work that they are expected to do; and beside this, the movements which carry the food into the stomach, while depositing the foodstuffs in this chamber for further attention, send on beyond the stomach peristaltic waves which reach the colon, and with such vigor that its contents move forward four times as fast during the eating of a meal as in the intervals between meals.

The Saliva.

The three pairs of salivary glands together produce daily three or four pints of saliva, about the same amount of secretion produced by the skin and also by the kidneys. The saliva differs from the sweat and the urine in the fact that it is reabsorbed.

The salivary secretion is absent in fishes. The saliva of dogs contains no ferment or digestive principle, probably because meat contains no carbohydrate for the saliva to act upon. The same is true of the saliva of infants.

Human saliva, like that of the big apes and other frugivorous animals, is very rich in ferments. In man, the character of the saliva is influenced by the nature of the substances in the mouth during mastication.

Nearly thirty years ago, the writer showed, experimentally, that the quality of dryness in the food is one of the most powerful stimulants of salivary activity. In the mastication of an ounce of dry toast without other flavoring than a small amount of salt, twice its weight of saliva was secreted in five minutes. An ounce of water held in the mouth for the same length of time was scarcely at all increased in weight. The movements of mastication increase the activity of the salivary glands, perhaps by increasing their blood supply. Acid and alkaline substances powerfully stimulate the flow of saliva, as do, also, savory substances and foods which appeal to the appetite. Pepper, as well as other irritating and distasteful substances, causes an abundant flow of saliva, as also do substances which give rise to nausea.

The chewing of hard, insoluble and hence tasteless substances does not increase the flow of saliva to any considerable extent. The saliva produced by the chewing of food is much more active than that produced between meals. The saliva produced by the chewing of paraffin will in four hours digest twice its volume of a one per cent. solution of boiled starch.

The saliva contains three digestive ferments. One of these simply liquifies the starch. Another, amylase, converts the starch first into dextrin and then into malt sugar, or maltose. A third completes the digestion of the starch by converting it into dextrose.

The saliva acts very slowly upon raw starch, and on the whole is much less active than is the pancreatic juice in the digestion of starch.

When first secreted, the amylase of the saliva is inactive. It is made active by very minute quantities of acids and alkalies, but is rendered inactive by strong acids and alkalies, also by bacteria.

The action of the saliva is not completed in the mouth, but continues for an hour or two after the food passes into the stomach, or until the gastric contents become sufficiently acid to arrest the activity of the salivary ferments. Recent experiments indicate that the activity of the saliva is resumed in the small intestine after it comes in contact with the alkaline intestinal secretions.

Conditions Which Hinder Salivary Activity.

Careful determination of the activity of the saliva made in the laboratories of the Battle Creek Sanitarium under the writer's supervision, show enormous differences in the digestive activity of different persons. In some cases its activity was found to be sufficiently great to enable it to digest all the starch ordinarily eaten, while in others the degree of activity was scarcely 1-10 or even 1-20 as great.

The average of a thousand cases taken at random from a series of more than 40,000 in which the activity of the saliva was carefully determined by the method devised by Sir William Roberts, showed the complete digestion of about half of all the starch liquified in the mouth and stomach.

Bacterial infections of the mouth and stomach interfere with the function of the saliva by rendering its ferment inactive. The saliva is also deteriorated by the excessive secretion produced by gum chewing and the chewing of tobacco. The saliva in such persons has very little ferment. The prolonged stimulation exhausts the secreting cells so that the saliva becomes inactive.

Taylor very aptly says of gum chewing and tobacco chewing:

"Vicious habits, like the vulgar chewing of tobacco or gum, keep the salivary glands constantly at work, and the results are as bad physiologically as the practices are reprehensible to good taste."

Recently reported observations indicate that imperfect insalivation of the food and incomplete salivary digestion interfere with gastric digestion not only by introducing the food into the stomach in an imperfectly comminuted form, but through the absorption of the pepsin by the undigested starch. It is thus evident that thorough chewing of the food is necessary both to insure the complete digestion of starch and also to promote gastric digestion. It is probable that in the majority of persons not more than a fourth of the starch eaten is digested by the saliva, and in many cases the proportion must be very much smaller than this.

Sir William Roberts, many years ago, showed that acetic and oxalic acids interfere with digestion by preventing the action of the saliva upon starch. The amount of acetic acid found in a teaspoonful or two of vinegar was shown to be sufficient entirely to stop the action of the saliva. Oxalic acid diluted to one part in 10,000 was found to arrest the action of the saliva completely. The injurious action of the fruit acids, citric, malic and tartaric, is comparatively slight.

Citric acid powerfully stimulates the flow of saliva, and the saliva produced is very active in digesting starch.

Tannic acid interferes with the action of the saliva. For this reason tea and coffee interfere with the digestion of starch and for this reason alone should be discarded, since they cause indigestion as well as other disorders of various sorts.

Protective Properties of the Saliva.

It is known that wounds in the mouth generally heal quite readily. Clairmont, of Vienna, has shown that the saliva possesses valuable properties as a cleansing agent. Although it has no direct bactericidal action upon such pathogenic organisms as the bacilli of typhoid fever and tetanus, the colon bacillus or pus-producing organisms, some bacteria are destroyed by contact with human saliva. The saliva of goats and other ruminants, especially parotid saliva, was found, moreover, to have quite marked bactericidal properties. Clairmont's observations led him to believe that the saliva maintains in the mouth conditions unfavorable for the growth of microorganisms which might otherwise fix themselves upon the teeth and gums and set up processes of decay or ulceration.

Pickerill and Gies urge the use of acids and sweets to stimulate the secretions of the mouth as the most efficient means of preserving the teeth. The teeth of the Maoris are immune to caries (Pickerill).

The Saliva in Disease.

Fleckseder (*Zentralblatt füer Innere Medicin*) calls attention to the fact that the saliva is acid in diabetes and also in cancer of the stomach, in leucemia, in pernicious anemia, jaundice, and sometimes in chlorosis. The chlorids may be increased or diminished according to the disease. When the chlorids of the urine are diminished, there is usually also a diminution of chlorids in the saliva. Sugar is sometimes present in severe cases of diabetes.

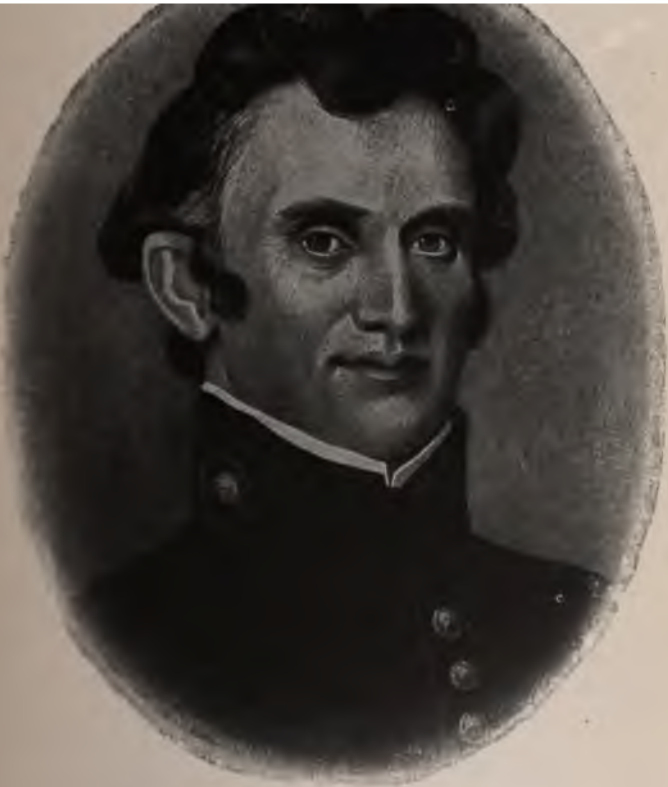
Diminished saliva (oligosialia) is present in many severe maladies, especially in cases of profuse sweating, insistent vomiting, dropsy, diabetes, anemia, cachexia accompanying carcinoma of the stomach, pernicious anemia, fever, uremia, and cirrhosis of the liver. When scanty, the saliva is cloudy and acid, and sometimes has a peculiar sweetish odor. In ptyalism the saliva is thin, alkaline and clear. A profuse flow of saliva occurs in pregnancy, in stomatitis, in most of the painful gastric affections, in nausea and ulcer of the stomach. An intermittent flow is frequently observed in cases of facial neuralgia, in the gastric crises of locomotor ataxia, and in neurasthenia.

Regulating Influence of the Sense of Taste.

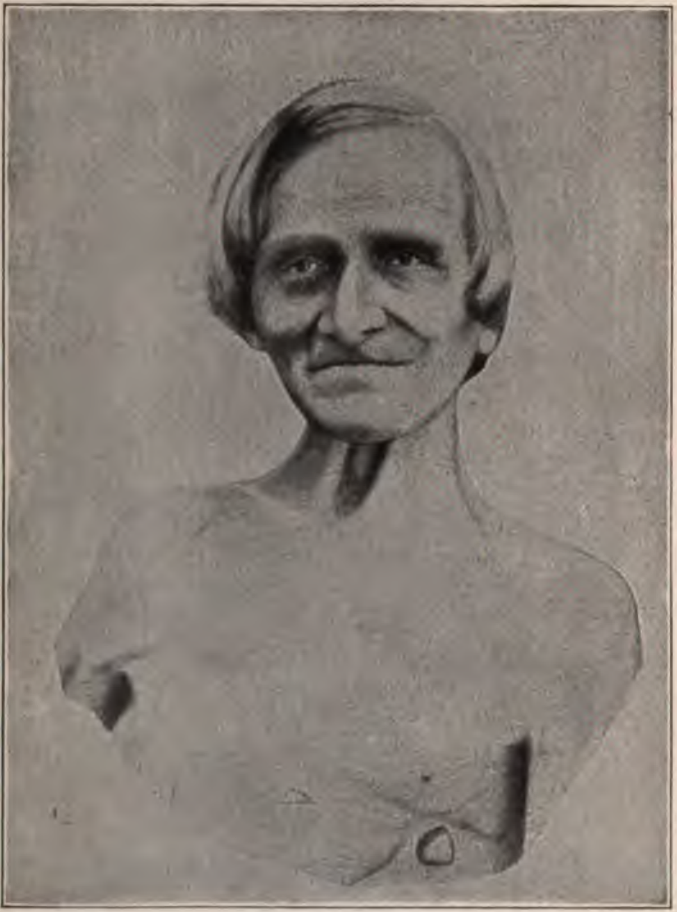
While food is in the mouth it is not only chewed but tasted. The recognition of the gustatory properties of the food by the nerves of taste, through reflex centers in the brain, prepares the stomach, pancreas, liver and other digestive organs for the work which they are to do. Tasting the food also in some mysterious way regulates the process of nutrition by cutting off the appetite for one food principle after another as the body has received a sufficiency of each particular item.

At the back of the mouth is found a remarkable structure, the soft palate, which is peculiarly sensitive to contact with solid objects. If the food is imperfectly chewed, the contact of coarse particles with the uvula and other portions of the soft palate gives rise to a reverse movement by which the food is carried back between the teeth to be more thoroughly masticated. This action of the soft palate is a sort of inspection intended to secure not only thorough mastication of the food but rejection of substances which are not food and which might do injury if swallowed.

The longer the food is retained in the mouth and the more thoroughly it is chewed, the larger the amount of gastric juice



DR. WILLIAM BEAUMONT



ALEXIS ST. MARTIN
Showing Opening in Left Side

(From "Life and Letters of Dr. William Beaumont," C. L. Mosby Co., St. Louis, Mo) which will be found in the stomach ready to act upon the food after it reaches the gastric laboratory. It is part of the function of the mouth laboratory, then, not only to digest the food and prepare it for the action of the other digestive organs but to regulate the nourishing of the body. In order that this regulating process shall be successful, it is necessary that the food should be so thoroughly chewed that its sapient properties may be fully developed and thoroughly appreciated. When this instinctive regulator of nutrition has been trained to normal action, it is a very dependable guide in determining not only the quality of the various foodstuffs which are needed to meet the requirements of the body, but also the amount of food which should be taken.

The importance of thorough mastication of the food will be discussed elsewhere. It may be mentioned here, however, that it is essential to good digestion, not only because by thorough chewing the food is comminuted, but for still another reason. Recent observations have shown that when large quantities of starch enter the stomach without having been changed by the action of the saliva, the pepsin may be absorbed by the undigested starch and thus gastric digestion may be interfered with and the acid of the gastric juice left free (Maxwell). The excess of free acid gives rise to gastric spasm, pain and various other inconveniences.

GASTRIC DIGESTION

The chief function of the stomach is the preparation of food for digestion in the intestine and to serve as a reservoir to hold the food while it is being doled out to the intestine in small quantities by the action of the pylorus. While the food is in the stomach about half the starch is liquefied, one-fourth the starch is converted into sugar, and three-fourths of the protein is liquefied but none of it is completely digested.

In the mucous membrane of the stomach are glands, some of which produce pepsin, others the gastric acid which is known to the chemist as hydrochloric acid. These two remarkable products cooperate in the digestion of the proteins of the food. Rennet, a milk-curdling ferment, is also produced in the stomach. The digestive work done in the stomach is not complete. It is rather of a preliminary character intended to complete the breaking up of the food so as to render each particle easily accessible to the other more powerful digestive juices which are brought in contact with the food after it leaves the stomach. It very naturally follows that very little absorption takes place in the stomach. The stomach, indeed, may be considered as an antechamber to the real food laboratory, the small intestine, where the chief work of digestion and absorption are done. According to the comparative anatomists, the stomach of man does only about one-fifth of the digestive work, while in the goat and the ox the stomach does seventy per cent. of the work of transforming the food.

The Gastric Juice.

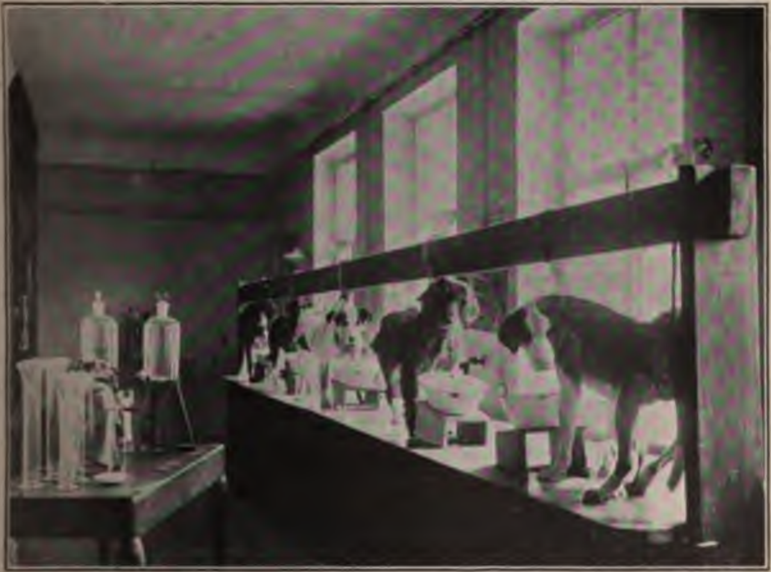
The quantity of gastric juice produced by the stomach in 24 hours is about three pints. The amount required for the digestion of a hearty meal, such as a dinner, the principal meal of the day, has been estimated as a little less than one and one-half pints.

The gastric juice is the product of six different sets of glands. Three of these secrete ferments, pepsin, rennet, and lipase, a fat-digesting ferment. Other glands secrete mucus, still others acid, and by another set of glands there is secreted a serous fluid termed diluting juice, which serves to regulate the acidity and digestive activity of the gastric juice.

It was formerly supposed that gastric juice is produced only during digestion. This belief was largely based upon the observations of Beaumont. But it may be noted that this shrewd observer remarked that he *usually* found the stomach empty, or at least that it contained only a small quantity of gastric juice, which he states sometimes amounted to one or two ounces. This quite agrees with the later observations of Carlson on a man having a gastric fistula similar to that of St. Martin, upon whom Beaumont's experiments were made. Carlson holds that the secretion is continuous, usually not exceeding one to two ounces per hour, but sometimes three to five ounces per hour. This continuous secretion possesses the properties of ordinary gastric juice, though usually less acid than the juice produced during digestion. The continuous secretion is absent in fevers and also when the stomach is the seat of inflammation or gastritis.

After the appearance in 1834 of Beaumont's interesting account of his experiments upon St. Martin, the knowledge of digestion was advanced very little until the publication in 1897 of Pavlov's remarkable treatise, "The Work of the Digestive Glands." This work provided, for the first time, a basis for rational medical dietetics. Previously so little was actually known respecting the physiology of gastric and intestinal diges-

PROF. J. P. PAVLOV OF PETROGRAD



PAVLOV'S DOGS PRODUCING GASTRIC JUICE

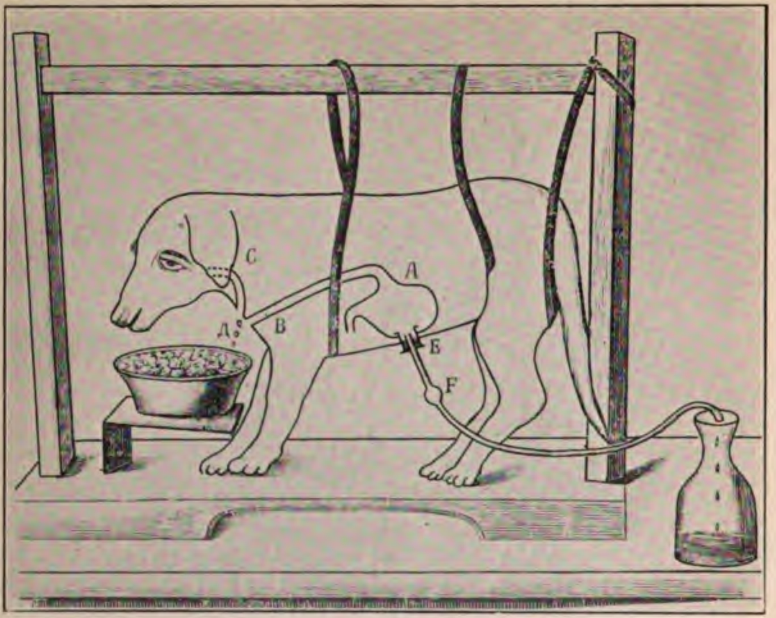


Fig. 1.—Experiment to Demonstrate Appetite Juice.

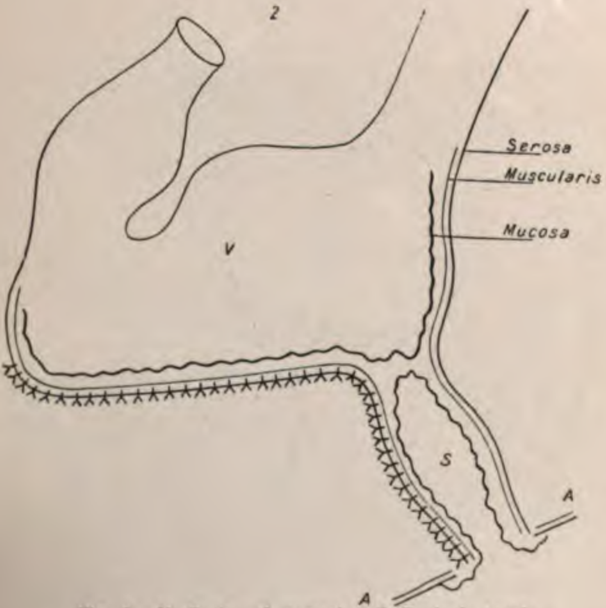


Fig. 2.—*V*. Cavity of stomach. *S*. Pavlov's pouch.
A.-A. Abdominal wall.

tion that medical dietetics, at least in relation to gastric and intestinal digestion, was almost wholly empirical or based upon vague and unproven theories.

The facts set forth by Pavlov were so extraordinary and so revolutionary that the writer thought it worth while, in 1907, to visit Petrograd for the purpose of getting a first-hand acquaintance with the work and views of this distinguished investigator, whom he found the most approachable, courteous, and communicative of men. The experiments which the Professor and his able assistants performed for the writer's benefit, not only confirmed the facts made known in his published works but made us acquainted with additional facts which at that time had not yet been published to the world.

Some of the most important facts in relation to gastric digestion were discovered by Pavlov through experiments made possible by an ingenious operation devised by him whereby the stomach of a dog was divided into two compartments, one of which was made use of by the dog for the digestion of his food, while the experimenter employed the other for his scientific observations. The latter, called by Pavlov the *kleine magen* (the little stomach), but generally known as Pavlov's pouch, had about one-tenth the capacity of the normal stomach. The experimental stomach was connected with the surface of the body so that its cavity, cut off from the rest of the stomach, could be drained by means of a tube and thus the secretion collected, measured and otherwise studied. The accompanying diagram, copied from Pavlov's work, clearly shows the method of forming the experimental stomach. The reader will also be interested in the several cuts from original photographs in which are shown Professor Pavlov and some of the wonderful dogs upon which his observations have been made.

Appetite Juice.

Pavlov found that within a few moments after a dog began chewing the food offered it, a stream of freshly secreted gastric juice started to pour from the little stomach into the receptacle provided to receive it. In fact, the secretion of gastric juice by the little stomach often began even before food had been taken into the mouth of the dog, provided it was allowed to see and smell appetizing food.

By another experiment Pavlov proved that if food was simply chewed and never allowed to enter the stomach, the stomach produced an abundant secretion of highly active gastric juice, which continued as long as the chewing continued. In one of the accompanying cuts is shown a group of dogs as seen by the writer at ten o'clock in the morning in Pavlov's laboratory, after they had been actively chewing food since six o'clock in the morning. Each dog had produced nearly a quart of gastric juice, although not a particle of food had entered the stomach, it being prevented from so doing by an operation upon his esophagus, whereby the food, when swallowed, was made to drop back into the pan from which he ate, instead of going into his stomach. The gastric juice produced under these conditions, by the simple chewing of food in the mouth, Pavlov designated by the term "appetite juice."

Miller and others have shown that the sight of food is a more powerful stimulus to gastric secretion than odor. Unpalatable food produces little or no appetite juice, though it may be ultimately well digested. Worry and mental strain cause delay in the development of appetite juice and hinder digestion. This effect is not produced by entertaining mental activity, such as reading a newspaper during meals.

The gastric juice secretion thus evoked by the tasting and chewing of food is strongly acid and possessed of a very high degree of digestive activity. At the time of the writer's visit the laboratory was doing quite an extensive business in the collection of gastric juice from the stomachs of dogs and shipping it to specialists in various parts of Europe for use by patients. Very remarkable results were attributed to its use, far greater than have ever been found to result from the use of the pepsin obtained from the stomach of the hog.

Appetite juice is produced at the average rate of about one-eighth of an ounce per minute, though it may be generated at a rate four times as great as this. Its secretion ceases as soon as the taste of food disappears from the mouth.

Appetite juice, like the continuous gastric secretion, is either greatly diminished or entirely absent in gastritis or any inflammatory disorder of the gastric mucous membrane, as well as in fevers. It is also stopped by pain and by strong emotions, as by anger and fear. Pavlov believed the function of the appetite juice to be to start the digestive process. He regarded it, in fact, as the most important part of the gastric secretion. The correctness of this view has been called in question in view of the fact that normal infants have no appetite juice, and that the digestion is apparently carried on in a normal way in dogs in which the nerves of the stomach have been divided so as to prevent the development of appetite juice, and also in persons having a gastric fistula through which food may be passed into the stomach without having been placed in the mouth. The fact is also recalled that in many cases of achylia, a condition in which no gastric juice is formed, digestion is apparently carried on by the small intestine in a perfectly normal way. The same is also true in cases in which the stomach has been removed. However this may be, it cannot be denied that appetite juice is a highly useful factor in digestion, and it seems probable that its absence must sooner or later give rise to impairment of digestion and nutrition.

When the tongue is coated, the food flavors cannot be appreciated by the nerves of taste, and as a result the gustatory reflexes are destroyed, appetite juice is not formed, and digestion may be suspended. (Roger).

Fats mixed with the food delay the development of appetite juice and diminish its quantity. Meat introduced into the stomach of a dog without passing through the mouth, digests after a very long time, but when taken through the mouth, five times as much will be digested in the same time, through the aid of the appetite juice which is produced. This experiment affords a most forcible demonstration of the importance of appetite and of mastication as aids to digestion. Bread placed in the stomach produced no secretion whatever, but when chewed in the mouth and swallowed, appetite juice was produced and the bread was readily digested. When a portion of the digesting bread was introduced directly into the stomach of another dog, gastric juice was promptly secreted.

Fats not only hinder the formation of appetite juice, but their presence in the stomach leads to a diminution in the production of chemical juice as well.

Pavlov showed that fats remain longer in the stomach than any other food principle, but after leaving the stomach they pass rapidly through the intestine.

The Chemical Juice.

The gastric secretion which appears in the stomach as the result of contact of the food with the gastric mucous membrane is called by Pavlov "chemical juice". The chemical juice appears to be called forth by various stimulating substances found in foodstuffs, particularly by the extractives of meat. Recent experiments, however, have shown that the most powerful stimulant of the gastric glands, is gastrin, a hormone which is formed when protein food is brought in contact with normal gastric juice in the stomach.

The chemical secretion, as well as the appetite juice and the continuous secretion, is arrested by fever, especially when the body temperature rises considerably. In health, active secretion of gastric juice is produced when gastrin is injected under the skin or introduced into a vein. When fever is present, this does not occur.

The Gastric Acid.

One of the most remarkable physical properties of the gastric juice is its acidity. The contents of the healthy stomach during digestion are always found to be highly acid. This is rarely ever due to fermentation but rather to the presence of hydrochloric acid. According to Debove, an eminent French physiologist, the hydrochloric acid formed by the gastric glands differs from the ordinary hydrochloric acid of the laboratory in being much more active. As secreted by the gastric glands, the acid has the same degree of acidity as that possessed by one-half of one per cent solution of hydrochloric acid, about 1.25 per cent. of the ordinary O. P. hydrochloric acid of the laboratory.

A solution containing hydrochloric acid in this proportion, if applied to the skin, would produce powerful corrosive effects. As soon as secreted, however, the strong acid solution is diluted by a limpid secretion generated for the purpose, known as diluting juice, so that the normal acidity of the gastric contents corresponds to a solution containing about two parts of hydrochloric acid in a thousand parts of water, or two-tenths of one per cent.

It is evident, then, that when matters vomited or regurgitated from the stomach have a strong acid taste, it is no certain indication that the food has fermented in the stomach, but may be proof that the stomach is making at least a normal amount of gastric acid. When there is fermentation of the gastric contents, a very rare occurrence, vomited matters have not only a sour taste but a sour smell as well, due to the presence of acetic acid, which is volatile at the temperature of the body, whereas hydrochloric acid is not volatile.

The normal stomach produces each day from one dram to two-thirds of an ounce of pure hydrochloric acid. Just how the stomach is able to produce this strong acid is not known, nor how the gastric mucous membrane alone, of all other body tissues, is protected from the destructive action of this highly corrosive liquid.

Hyperacidity.

The acidity of the gastric contents during digestion is not usually found so high as .5 per cent., being normally about .2 per cent. This is also the acidity of the continuous secretion found in the empty stomach when mixed with saliva which has been swallowed and liquids which have entered the stomach from the intestine.

When a higher degree of acidity of the gastric contents is found, it is not because the gastric glands produce a secretion having too high a per cent. of acidity, but because an excessive amount of secretion of the normal degree of acidity is produced, or because the amount of diluting juice is deficient. The gastric glands cannot make an excessively acid gastric juice. In cases in which the condition known as hyperacidity exists, the acidity may be either higher or lower than that ordinarily found in the gastric contents or may be equal to the normal; hence it appears that hyperacidity may be really attributable to an abnormal sensitiveness rather than to an abnormal secretion of gastric acid.

Pepsin.

This ferment is the most important of the several ferments found in the gastric juice. As secreted, it is not active, but only becomes an active digestive agent when activated by combining with hydrochloric acid.

The amount of pepsin contained in the pint and a half of gastric juice produced in 24 hours is about seven and one-half grains. The 20 or more ounces of gastric juice required for the digestion of a hearty dinner contain four grains of pepsin, sufficient to digest one and two-thirds pounds of egg white or three and one-third ounces of dried albumin, nearly double the amount required for a full day's ration. It is thus apparent that the daily production of pepsin is sufficient to digest four times the amount of protein which the body requires.

Except when the gastric glands are destroyed by degeneration, pepsin is usually secreted in abundance. It is for this reason that the feeding of pepsin as a remedy is useless as an aid to gastric digestion. Some years ago an experiment upon a dog was made by a French physiologist which still more clearly demonstrated this fact. By means of tubes passed into the dog's stomach, a stream of water was allowed to flow into the stomach through one tube and out of the other, until more than 2,000 quarts of water had been passed through the stomach. The digestive activity of this water was tested by the addition of hydrochloric acid and was found to be such that the amount of pepsin present was sufficient to digest an amount of flesh more than equal to the weight of the dog.

When the gastric acidity is excessive, the digestive power of the gastric juice may be greatly lessened by the destructive action of the acid upon the pepsin.

The presence of bile in the stomach prevents the action of pepsin, even though the gastric contents may still remain acid. The bile precipitates the pepsin. Pepsin is readily digested by trypsin, a ferment produced by the pancreas, and hence its action does not continue after the food leaves the stomach.

Lipase.

Roger, of Paris, and others have in recent years called attention to the interesting fact that the stomach secretes a lipase, or fat-digesting ferment, which is very active in the digestion of emulsified fats such as cream and egg yolk.

In this connection it is interesting to note the fact that while the principal digestive work of the stomach is to digest proteins, provision is made also for the digestion of starch and fat. Thus, by the cooperation of these several digestive agents in the stomach, the food may be completely broken down and so prepared for the more vigorous digestive action of the pancreatic juice and the finishing work of the intestinal juice to which the food is subjected in the intestine. When large quantities of fat are eaten, the intestinal fluid, consisting chiefly of a mixture of bile and pancreatic juice, is often regurgitated, the evident purpose being to aid in the digestion of the fat when the quantity is greater than the gastric lipase is able to deal with. This regurgitation of bile from the intestine is most likely to occur in cases of high acidity, a condition which interferes with the action of the lipase of the stomach and may even destroy it. The alkaline intestinal fluids, by neutralizing the acid gastric juice, aid the digestion of the fat and so hasten its departure from the stomach.

Functions of the Hydrochloric Acid of the Gastric Juice.

The hydrochloric acid of the gastric juice plays a remarkably versatile role, as will be seen by the following enumeration of its uses:

1. Activates pepsin. As secreted, pepsin has no digestive activity, but in the presence of hydrochloric acid it acquires an astonishing digestive potency by which it is able to transform the various proteins of the food into peptone, although it does not actually complete the digestive process. Pepsin-hydrochloric acid is the only agent by which raw connective tissue can be digested in the body. It is evident, then, that in achylia, when pepsin and hydrochloric acid are no longer produced in the stomach, flesh foods should be entirely discarded.

It may be mentioned in this connection that in the absence of hydrochloric acid, pepsin may be to some degree activated by food acids,—citric, malic, and tartaric acids. It should also be noted that when both hydrochloric acid and pepsin are absent from the gastric juice, the ferments may be made to reappear by the introduction of hydrochloric acid or acid protein into the stomach. (Taylor). If, after the use of hydrochloric acid in this way the ferments do not appear, it is evident that the gastric glands have undergone degeneration. It is desirable that this test be made in all cases of achylia.

2. Activates chymosin and lipase. The chymosin, or rennet, of the gastric juice coagulates milk and the lipase digests fat.

3. Opens the pylorus. According to Cannon, the presence of free hydrochloric acid in the stomach in sufficient amount causes the pylorus to open. It is known, however, that in achylia, in which there is no acid in the stomach, the pylorus often remains open and the food passes out more quickly than from the normal stomach.

4. Closes the pylorus. When the acid contents of the stomach enter the duodenum, the pylorus is closed by a reflex action. Failure of the pylorus to close is probably the cause of the rapid emptying of the stomach in achylia.

5. Stimulates the secretion of pancreatic juice.

6. Causes contraction and emptying of the gall-bladder.

7. Disinfects the food, destroying bacteria and other organisms.

The gastric juice does not destroy all bacteria, but it has been clearly demonstrated that most pathogenic or disease-producing bacteria do not survive prolonged contact with normal gastric juice.

8. Stimulates the production of pepsin by the gastric glands.

9. Stimulates the movements of the stomach. Cannon proved that the tonus of the stomach walls, as shown by the pressure within the stomach, was four times as great with acid contents as with neutral contents.

10. Closes the cardiac orifice after the swallowing of food.

The acidity of the gastric juice is increased by the following:

Hunger
Water
Gastric juice
Lean meats
Meat extracts
Bouillon and animal broths
Milk, especially buttermilk and skimmed milk
Cane sugar
Undigested cooked starch
Dextrin
Sodium chlorid (common salt)
Carbonated water
Agreeable foods
Strongly flavored foods
Condiments
Cold baths
Sleeping after meals
Imperfect mastication of food (chemical juice)
Prolonged chewing of food (appetite juice)
Acids (especially butyric, oxalic and tannic)
Tea and coffee
Alcohol
Worry
Disease of the gall-bladder
Gastric ulcer
Duodenal ulcer
Constipation

According to Taylor, "There are experiments with animals indicating that increased bacterial action in the intestine, aiding the formation of a large amount of fatty acid (also other toxic substances, such as bacterial peptone, etc.), provokes in some way an increased secretion of hydrochloric acid in the stomach." The writer has noted a very constant association between intestinal toxemia and gastric hyperacidity or hyperhydrochloria.

Hypersecretion, or hyperacidity, may be intermittent or continuous. It is a common symptom in connection with hysteria, chlorosis, and neurasthenia, so-called nervous dyspepsia, a condition which is probably due to chronic intestinal toxemia.

The acidity of gastric juice is lessened:

1. By fats, cream and oils, especially olive oil when perfectly fresh and free from rancidity.
2. Grape sugar.
3. By the use of soft foods and purees, which should be eaten with very little mastication.
4. By bland foods.
5. By a saltless diet.
6. By sweating baths or by profuse perspiration induced by exercise, which causes the elimination of salt.
7. By fatigue.
8. By disease—fever, cancer, degeneration of gastric glands (achylia), cachexia, pernicious anemia. Hydrochloric acid is often absent or diminished in Bright's disease, chlorosis, and pronounced secondary anemia.
9. About one-fourth of the hydrochloric acid secreted by the stomach is absorbed or neutralized by mucus.

According to Pavlov, egg albumin has no effect upon gastric secretion. He found the same true of undigested starch, solid fats and hydrochloric acid.

Bitters Do Not Increase the Secretion of Gastric Juice.

The observations of Carlson and others have clearly demonstrated that, contrary to popular belief, bitters do not increase the production of gastric juice. Reichmann and Schœffer have shown, in fact, that the presence of bitters in the stomach has the effect to lessen the secretion of gastric juice. From these experiments, it is evident that the age-long faith in bitters as a means of promoting digestion has no scientific basis. *Bitters hinder instead of aiding gastric digestion.*

Excessive Secretion of Water by the Stomach.

Loss of power to secrete water, or diluting juice, is the last functional failure in disease of the stomach. Excessive secretion of water frequently occurs in dilatation of the stomach. It is a common symptom in chronic gastritis. It may also occur in cancer of the stomach and atrophy of the stomach with dilatation. Failure of the water-secreting function of the stomach occurs in advanced atrophy, gastritis, cancer, and in all cases of achylia.

DIGESTION IN THE SMALL INTESTINE

The small intestine performs the greater part of the digestive work and is the only part of the alimentary canal in which the work of digestion is carried to completion. It is also the chief organ of absorption, practically no absorption of digested foods taking place from either the stomach or the colon. Both the stomach and the colon may be removed without serious interference with digestion or nutrition; but removal of any considerable portion of the small intestine is dangerous to life.

Using a domestic analogy, the stomach may be considered the kitchen of the body and the small intestine the dining-room. In this part of the alimentary canal, which is about 22 feet in length, the food is disposed of so rapidly that at the end of 8 hours from the time the food enters the stomach, all of its usable elements have been digested and absorbed.

The small intestine absorbs something more than 6 quarts every 24 hours. This amount includes not only the liquids taken in the form of food and drink, but the pancreatic juice, the gastric juice and other digestive fluids which are poured into it. The rapid absorption which takes place in the small intestine is made possible by the five million villi which hang out into the interior of the gut and which in some respects resemble the minute rootlets of a plant. Indeed, the villi may be regarded as the roots of the body, while the foodstuffs which pass over them along the intestinal canal correspond accurately to the soil which surrounds the rootlets of a plant. Each of the five million villi of the small intestine absorbs about one ounce of liquid in a lifetime of 60 years. So minute are the villi and so delicate is this part of the digestive machinery that a single villus working steadily for eight weeks is able to absorb barely one drop of liquid.

In the small intestine the digestive process is fully completed, the useful products of digestion are absorbed, and the unusable residues, together with the bile, mucus and various body wastes which are eliminated by the intestine, are pushed on through the ileocecal valve into the colon, their return to the small intestine being prevented by the check-valve action of this remarkable anatomical structure.

In the intestine the food comes in contact with three digestive juices: the pancreatic juice, the bile, and the intestinal juice. The pancreatic juice contains six ferments, besides activating substances. These are as follows: *Trypsin,* which digests protein; *lipase,* which digests fat by converting it into soap; *amylase,* which converts starch, dextrin, and malt sugar into dextrose; *chymosin,* or rennet, which coagulates milk; *invertase,* which digests cane sugar, converting it into dextrose and levulose; *lactase,* which digests milk sugar, converting it into dextrose and galactose.

Acids stimulate the secretion of pancreatic juice. This is true of food acids as well as of the hydrochloric acid of the gastric juice. Hence, when the normal gastric juice is absent, acid fruits should be freely used to encourage pancreatic secretion and intestinal digestion. Water drinking also increases pancreatic secretion, as do fats and alkalies; but alkalies diminish the activity of the pancreatic juice while increasing its volume. An excessive quantity of hydrochloric acid lessens the activity of the pancreatic juice, although increasing the amount.

There is an appetite pancreatic juice as well as an appetite gastric juice. The secretion of appetite pancreatic juice begins, in fact, before the appetite gastric juice secretion begins. Pancreatic secretion is greatly increased by gastric hyperacidity.

The ferments of the pancreatic juice, like those of the gastric juice, are not active when first formed by the glands. They only become potent agents for digestion when they have been activated by the bile or by bacterial products. Sometimes bile as well as bacteria reach the pancreas through the pancreatic duct and activate the pancreatic ferments, giving rise to autodigestion of the pancreas and pancreatitis. This occurs as the result of disease of the gall-bladder and bile ducts, and is probably a common cause of diabetes.

The amylase of the pancreatic juice differs from that of the saliva in the fact that it is much more active and is able to digest raw starch. It is for this reason that the starch of the food is usually all digested, little or no starch being found in the feces. This is, unfortunately, a disadvantage, since starch or sugar is needed in the colon to promote the growth of lactic acid-forming germs which are necessary to maintain the activity of the colon and to hinder the growth of putrefactive organisms.

Amylase, or the starch-digesting ferment of the pancreatic juice, is not often found in the colon. It is likely to be found, however, when starch is present, as starch seems in some way to protect the ferment. On this account it is desirable to take regularly with the food a sufficient amount of raw starch to insure the presence of a certain amount of starch in the feces. This may be accomplished by eating freely of uncooked vegetables containing starch, or to avoid overcooking of oatmeal and other cereals. The Scotch eat their oatmeal scalded rather than cooked. This practice has been in vogue in Scotland for centuries and doubtless with great advantage to the Scotch people. For some years the writer has followed a similar plan, requiring oatmeal to be cooked only 8 or 10 minutes instead of 30 minutes or more, the customary time. The use of cereals prepared in this way renders great service in regimens for changing the intestinal flora.

Hyperacidity impairs the activity both of the amylase and of the trypsin of the pancreatic juice and hence may interfere with the digestion of starch and protein in the intestine as well as in the stomach. In cases of diabetes the pancreatic secretion may be so much depreciated that the protein of the food is not properly digested. This matter should be investigated in such cases. It is possible to obtain a sample of the pancreatic juice for examination by means of a duodenal tube.

The Intestinal Juice.

The intestinal juice is in some respects the most remarkable of all the digestive fluids. It contains eight ferments as follows: *Erepsin,* which completes the digestion of protein and is in this respect the most efficient of all the ferments which deal with protein; *amylase,* which digests starch; *lipase,* which digests fat; *chymosin,* which coagulates milk; *maltase,* which converts maltose into dextrose; *lactase,* which digests milk sugar. converting it into galactose; *invertin,* which digests cane sugar, changing it into dextrose and levulose; and *emulsin,* which emulsifies fats.

The Bile.

The bile, produced by the liver, is secreted continually, even during starvation, although it is increased after meals. The amount of bile produced depends somewhat upon the diet. It varies from a pint to a quart daily, averaging about 20 ounces.

The importance of the bile is shown by the fact that the liver of the horse secretes thirteen pints of bile in twenty-four hours. The liver of an ox secretes nearly one-half as much; that of a sheep three-quarters of a pint.

A portion of the bile is absorbed and again secreted, so that it becomes in this way concentrated. There is in this fact some justification for the idea that the bile becomes vitiated so that one is benefited by getting rid of a portion of it. Lauder Brunton noted many years ago that the bile from a biliary fistula lacks the bitter taste of bile, doubtless for the reason that it has not been concentrated by reabsorption. There may be some truth in the common notion that one is benefited by getting rid of a portion of bile through vomiting or purging.

The amount of bile produced is greatly increased by a hearty meat diet. The free use of fats also increases the secretion of bile. Bile contains no digestive agent, but aids in the digestion of fats and also encourages the absorption of digested fats. It also contains substances which activate the ferments of the pancreas. The presence of bile hinders the growth of bacteria, and it is also believed that bile neutralizes to some extent the poisonous products produced by bacteria.

It is evident that in the absence of bile the amount of protein and fat should be reduced, so as to lessen the liability to injury from putrefactive processes in the colon. The digestion of fats is interfered with by the absence of bile; hence the intake of fat should be reduced when the entrance of bile into the intestine is interfered with, as in jaundice and during drainage of the gall-bladder.

The loss of bile through drainage of the gall-bladder does not apparently produce any serious impairment of health, as the body seems to be able to readily compensate the loss of the bile. It is necessary, however, that great care be taken to regulate the diet so as to lessen to the greatest degree possible the tendency to intestinal putrefactions.

Intestinal Absorption and Excretion.

The great activity of the small intestine as compared with the colon is seen in the fact that the latter organ, capacious as it is, ordinarily absorbs only about 10 ounces of liquid in 24 hours, or one-twentieth as much as the small intestine. This great activity of the small intestine as an absorbing organ is an indication of the great importance of the function of the ileocecal valve in preventing the reflux of refuse, perhaps in a putrefying condition, from the colon into the small intestine. Comparatively little harm results so long as these refuse matters remain in the colon, even though there is some putrefaction, although normally no putrefaction occurs in any part of the alimentary canal. But when putrefying materials back up into the small intestine, they are rapidly absorbed, and serious mischief results, as shown by attacks of so-called biliousness, headache, sleeplessness, skin disorders, and the highly varied symptoms of intestinal toxemia.

The large intestine is the channel through which the waste iron, lime and other metals are eliminated. Practically all of the iron, amounting to about one-sixth of a grain daily, finds its way out of the body through this channel.

TRANSPORTATION OF THE FOOD

The statements made in this section are based upon the careful observations of Cannon, Hertz, Carlson, Case and others who have made extensive observations upon the movements of the stomach and intestines by the aid of the X-rays.

The alimentary canal is a transportation system as well as a series of laboratories, the tube being divided into sections separated by gates through which the food is moved from one part to the next by contraction of its muscular walls. This movement is termed peristalsis.

There are ten gates. Of these, one is placed at each end of the canal,—the mouth to guard the entrance and the anus to protect the exit.

Next to the mouth we find the soft palate, by which the food is inspected as to its consistency and fitness for swallowing.

The third gate is located at the upper end of the esophagus, or gullet, and is kept constantly closed except when food or water is being swallowed.

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Swallowing.

After the food has been chewed it is gathered upon the surface of the tongue, the tip and edges of which are pressed against the teeth and the roof of the mouth, the soft palate is drawn up so as to close the posterior opening into the nasal cavity, and by a backward movement the tongue is made to act like a piston, forcing the food against the soft palate and the back of the pharynx. At the same time the larynx rises and is pulled forward, opening the upper end of the esophagus, and the epiglottis moves downward with a quick jerk which tosses the food into the open gullet. As the act of swallowing terminates, the solid substances are grasped by the circular muscles at the upper end of the gullet and by peristaltic movements are slowly moved toward the stomach, into which they enter at intervals as the cardiac sphincter relaxes. Liquid foods move down more rapidly than solids, being squirted some distance down the esophagus. A partial vacuum exists in the lower part of the esophagus which by suction greatly facilitates the movement of food in the right direction, a device which is certainly marvelously well adapted to the purpose for which it is designed.

In the mouth the food is acted upon by voluntary muscles. When the work of these muscles is done, the food is tossed or squirted down the throat to come within grasp of the involuntary muscles which from this point automatically control the movement of the food along the digestive canal. The act of swallowing is reflex. One cannot swallow except when some object is brought in contact with certain sensitive spots located at the base of the tongue, the upper surface of the soft palate and especially the back wall of the throat. These sensitive spots differ from other reflex areas in the body in that they do not become fatigued but are always ready to respond when stimulated. This makes it possible to swallow many times in succession without difficulty. When a morsel of food starts on its journey down the esophagus, the cardiac orifice is notified and opens at the right time to receive the morsel when it arrives. If cocaine is applied to the throat, the sensitive areas are benumbed and the swallowing reflex is lost. The opening of the cardiac orifice to permit the entrance of the food into the stomach is in harmony with a general law governing the entire digestive tube, by which a wave of relaxation always precedes a wave of contraction.

Certain drugs, as adrenalin, cause relaxation of the cardiac orifice. The cardiac orifice contracts more strongly after cold drinks and carbonated water than with warm water. It is for this reason that warm water is taken to encourage vomiting. The cardiac orifice contracts with sufficient vigor to resist a pressure equivalent to ten inches of water or about six ounces to the square inch.

The gastric walls contract when the stomach is empty, gradually relaxing to accommodate themselves to the accumulating contents during the taking of food or liquids. This adjustment of the stomach to the volume of its contents is shown in the disappearance of fullness, sometimes felt during a meal, after ceasing to eat for a few minutes. The contraction of the cardiac sphincter is due to stimulation by the acid of the gastric juice as the pylorus is closed by a reflex produced by contact of the gastric juice with the intestinal mucous membrane. When the gastric acid is deficient, both the pylorus and the cardiac orifice may be relaxed, a condition which encourages intestinal infection and autointoxication.

When gas escapes from the stomach it is due to the fact that gases accumulated in the upper part of the stomach prevent contact of the acid gastric juice with the mucous membrane near the cardiac orifice. In consequence its closure is prevented. As the gas escapes, the fluid rises and comes in contact with the mucous membrane about the cardiac sphincter which is then closed.

Movements of the Stomach.

The movements of the stomach have been very carefully studied by many observers. It was formerly supposed that, when empty, the stomach remained quiet. The observations of Carlson have demonstrated that this is an error and that the empty stomach is always active. A high degree of activity gives rise to so-called hunger pains. Hunger is always associated with contractions of the stomach. When food is received the movements become slower and one is no longer conscious of them.

During digestion contraction waves pass over the stomach at the rate of three per minute. When the contents of the stomach are highly acid the rate may be increased to five or even six waves per minute. There are also other influences which control the rate of gastric peristalsis. When considerable fat is present in the food the waves are less frequent and less vigorous.

Proteins produce more frequent waves than fats. The most frequent waves are caused by the presence in the stomach of starch or sugar. These gastric contractions continue until the stomach is empty, which sometimes requires several thousand waves, although if the pylorus opened at each wave, the entire contents of the stomach would be passed into the intestine in two minutes.

When the gastric juice is diluted by the swallowing of liquids, the waves are slowed, increasing again when the gastric contents become strongly acid. In vomiting, the cardiac end of the stomach is wholly relaxed, although strong waves may occur in the pyloric end of the stomach.

When vomiting is induced the cardiac end of the stomach is relaxed. The diaphragm and the abdominal muscles contract in such a way as to press the stomach between them, squeezing out its contents. The act of vomiting is almost wholly passive. When contracted, the stomach is reduced in circumference to about one-fifth that in its relaxed condition. In adjustment to accommodate the gastric contents when the stomach is distended, the muscular fibers of its walls slip by and the same thing happens with the abdominal muscles in relaxing to adjust themselves to distending contents. Consequently the pressure within the abdominal cavity may not be increased although the volume of the abdominal contents, as in the case of a dog after a large meal, may be doubled.

In the taking of food the successive morsels are arranged in strata in the cardiac end of the stomach, the last food swallowed being found in the center.

The two parts of the stomach really have two distinct functions, the left or cardiac end is a reservoir in which the food is dissolved and disinfected. This end of the stomach also secretes hydrochloric acid which disinfects the food. The right half of the stomach kneads, churns, and manipulates the food, reducing it to the consistency of soup and finally spurting it into the duodenum.

The pylorus has a curious selective action which was noted by the ancients; hence its name, which literally means gate keeper.

Passage of Foods from the Stomach.

In passing from the stomach into the duodenum, the gastric contents are spurted some distance along the intestinal canal.

Carbohydrates pass out of the stomach most rapidly. Next in order are the proteins and lastly, the fats. Bread begins to enter the small intestine within ten minutes after eating. Potato leaves the stomach rapidly, perhaps because it is acted upon by the gastric juice only to a very small extent. At the end of half an hour eight times as much carbohydrates have left the stomach as of protein. Fats retard the passage of both carbohydrates and protein from the stomach when present in considerable amount. When the gastric contents of the stomach remain alkaline their passage from the stomach is delayed.

It has been shown by Vogeler and others that hypersecretion and acidity are accompanied by low motility and the reverse. Where there is an excess of acid in the gastric fluids, the entrance of this strongly acid material into the duodenum causes a prolonged closure of the pylorus.

Acids delay the passage of food from the stomach by increasing the secretion of gastric acid.

Acid protein, that is, protein to which acid has been added, passes through the pylorus much more rapidly than does ordinary protein.

Protein is discharged more slowly than starch because it combines with the free hydrochloric acid and so delays the opening of the pylorus.

Fat remains long in the stomach for the reason that when fat enters the duodenum it closes the pylorus just as does the gastric acid. The purpose of this is to prevent the entrance of fats into the intestine only at such a rate as will permit them to be absorbed.

Another reason for the slow passage of fats from the stomach is that they lessen the activity of the acid-forming glands.

Fat stimulates the flow of pancreatic juice. This is necessary because in the presence of fats the secretion of hydrochloric acid, which is also a stimulant for the pancreatic secretion, is lessened.

When fats are taken in large quantities the pancreatic juice and bile flow back into the stomach.

Water begins to pass into the intestine almost as soon as it is swallowed. A pint of water may pass out of the stomach in 30 minutes.

Water excites the acid-forming glands. This is an important provision whereby the normal stomach is kept supplied with gastric juice even when containing no food, which is necessary to prevent the growth of molds and bacteria in the stomach.

When fats and carbohydrates are fed together the carbohydrates are discharged slowly. Fats and protein fed together are discharged still more slowly. Fats hinder the secretion of gastric acid and the protein absorbs a considerable portion of what little acid is secreted, thus causing great delay in the opening of the pylorus.

Hyperacidity causes delay in the emptying of the stomach by keeping the pylorus closed. A solution of hydrochloric acid of a strength of .7 to .8 per cent causes continued spasm of the pylorus.

Since it has been shown that the gastric acid is never secreted at greater concentration than .5 per cent., it seems clear that pyloric spasm is really the result of a hypersensitive state of the gastric mucous membrane or a reflex disturbance from a diseased gall bladder or some other source.

Gas in the stomach hinders peristalsis by preventing contact of the food with the gastric walls. This is especially true when the position is horizontal.

The Effects of Heat and Cold.

There are clinical facts which indicate that extreme heat and cold applied to the surface of the body influence the action of the intestinal muscles. For example, it is well known that the cold bath and exposure to cold air have a decided influence in producing hunger and appetite. The prolonged cold sitz bath increases constipation by producing a spastic or contracted condition of the colon.

For many years the writer has regularly prescribed as a means of encouraging appetite, an ice bag placed over the region of the stomach for half an hour before meals. Hot applications over the stomach lessen appetite. Hot applications over the abdomen and the hot enema cause relaxation of the spastic colon. Levin has shown that warm water leaves the stomach much faster than cold water.

The Movements of the Small Intestine.

Peristalsis is the process by which the food is moved along the alimentary canal from one section to another. There are three forms of peristalsis:

First, a slowly advancing contraction which moves through a short distance in an intestinal loop. This is the ordinary method by which the food is moved along the digestive tube. The rate of advancement is half an inch to an inch a minute.

A second form of peristalsis is a wave movement that sweeps rapidly over a large part of the intestine, sometimes from one end to the other, without pause. This form of peristalsis is known as peristaltic rush.

Another movement which occurs in the small intestine is the so-called segmentation, which consists of a churning movement and simple manipulation of the food with little or no advancement. Peristaltic movements are in general in one direction, from above downward, but under some circumstances the direction of the movement may be reversed. The peristaltic rush occurs after the administration of a purge and is sometimes observed after a stimulating enema, as of soap suds, or diluted molasses or lemon juice.

The time required for food to pass from the stomach to the colon differs with different foods, being four hours for carbohydrates, five hours for fats, and six hours for proteins. Cannon observed that coarse *bran not only stimulates gastric peristalsis but also moves through the small intestine with unusual rapidity.* Vegetable foods in general pass through the intestine more rapidly than animal foods because of the presence of cellulose and the larger amount of protein and fat in flesh foods.

According to Cannon, when a horse eats oats, although its intestine is more than twice as long as the human, the material passes through the small intestine in a shorter time than in man.

Irritation of the colon slows the passage of food from the stomach and also its movement through the small intestine.—(Carlson).

The Movements of the Colon.

The contents of the small intestine, when discharged into the cecum, are nine-tenths water. In the cecum two-thirds of this water is absorbed. According to Roith, the contents of the transverse colon have as great a consistency as those of the rectum, which shows that little absorption occurs in the lower half of the colon.

When the colon becomes filled with fecal matters, peristalsis ceases or is greatly slowed.

The peristaltic waves of the colon begin in the middle of the transverse colon. The duration of the wave movements is four to five minutes. Antiperistaltic waves, starting at this point, pass backward to the cecum at intervals of 10 to 20 minutes. These waves occur in groups at the same rate as the peristaltic waves of the stomach, about five per minute.

Enemas excite antiperistalsis in the colon and stimulate the movements of the small intestine. The antiperistaltic waves set up by the enema are often very vigorous and may often continue for an hour or more. This is doubtless one cause of the frequent retention of the enema, the water injected being held in the cecum by antiperistalsis.

Activity of the colon is stimulated by the entrance of food from the small intestine through the ileocecal valve. Both peristaltic and antiperistaltic waves occur. Although strong antiperistaltic waves force the contents of the cecum back against the ileocecal valve this structure is so efficient a check valve it prevents the passage of material from the colon into the small intestine. At least this is true when the valve is intact. Cannon reports that although he has watched this movement hundreds of times, he has never but twice seen material pass from the colon into the small intestine. In one of these cases the colon of the animal had been greatly distended by the introduction of water.

The ileocecal valve, which exists in all vertebrate animals, is provided with a special nervous control distinct from that of any other part of the intestinal canal, showing that this is an important and essential structure to maintain the normal forward movement of the food residues and wastes pushed into the colon from the small intestine. Without the ileocecal valve antiperistalsis would continually drive back into the small intestine the contents of the colon and thus prevent its forward movement.

Says Cannon, "Antiperistalsis in the colon gives new meaning and value to the location of a sphincter or valve at the opening of the ileum. For, inasmuch as the valve is normally competent, the constrictions repeatedly coursing toward it force the food before them into a blind sac. The effect on the contents must be the same as the effect seen in the stomach when the pylorus remains closed before the advancing waves. The confined material is pressed upon by the approach of each constriction; but since it cannot go onward in the blind sac, and is, moreover, subjected to increasing pressure as the constriction comes nearer, it is forced into the only way of escape—i. e., away from the cecum through the advancing constricted ring. About twenty-five waves in the cat affect thus every particle of food in the colon during each normal period of antiperistalsis. The result must be a thorough mixing of the contents, and a bringing of these contents into close contact with the absorbing wall—a process which has already been variously repeated many times in the stomach and in the small intestine. The last remnants of value in the food, with some of the water, are here removed; and the waste is passed onward into the distal colon to be ejected from the body."

According to Hertz, the time required for the food to pass through each of the three parts of the colon is two hours.

The movements of the colon are about fifty per cent. less active during sleep than during the waking hours.

The taking of food greatly accelerates the movements of the colon. Hertz observed more progress of the residues in the colon during a meal hour than during four previous hours.

Under normal conditions, when the colon is kept free from accumulating residues, the new materials brought into it "are moved onward into an empty distal section by a sudden push lasting a few seconds." (Holzknecht.) Three or four such pushes of three seconds each are sufficient to transmit the food residues from one end of the colon to the other.

According to Hertz, the entire colon is emptied by a single contraction in normal defecation. In constipation, and in those whose bowels move but once a day, only the lower part of the colon is emptied.

The intra-abdominal pressure in the rectum during defecation is 4 to 8 times the ordinary pressure. It may amount to two to four pounds to the square inch. When the abdominal muscles are weak, as the result of bad posture, improper dress, or neglect of exercise, the intra-abdominal pressure may be insufficient to secure thorough emptying of the colon. This is undoubtedly one of the most common causes of constipation.

As regards the time required for the complete transit of the alimentary tract, Cannon says: "If approximately nine hours are required for material to reach the descending colon in man, the waste from food taken at eight o'clock in the morning might be discharged at five o'clock in the afternoon."

Evidently the normal rhythm would secure three bowel movements daily, or a bowel movement after each meal. Unfortunately the normal condition is rarely found among civilized people, who almost universally suffer from chronic constipation through neglect. Cannon says, "If the signal is not soon obeyed, it ceases to be given; the feces may then remain long in the rectum without calling forth sensations, and the defecation reflex be to that extent impaired."

The effects of certain drugs upon peristalsis is very pronounced. Nicotine at once abolishes peristalsis in the small intestine. Adrenalin stops peristalsis of the stomach immediately and causes intra-gastric pressure to fall to zero.

The Nerves of the Alimentary Canal.

The activities of the alimentary canal are controlled by three sets of nerves. First, the motor nerves, consisting of the two pneumogastric nerves which control the food tube from the esophagus to the lower end of the ileum; and the sacral or pelvic nerves which control the colon and the ileocecal valve. Second, the sympathetic nerves, the action of which is to inhibit or control the action of the motor nerves. Third, nerve ganglia located in the walls of the gut.

The tonus or tonic contraction of the stomach, when empty, is due to the local nerves in the walls of the stomach. The peristaltic waves may continue even after the stomach has been removed from the body of an animal provided it is kept in a warm salt solution. Peristaltic and antiperistaltic waves of the colon and the segmenting or churning movements of the small intestine are likewise due to local nerves.

The pneumogastric nerves control the pylorus and cardiac orifice. When these nerves are stimulated, the pylorus contracts and the cardiac orifice relaxes, an admirable arrangement which makes vomiting possible as a means of emptying the stomach. This arrangement also provides for the entrance and rejection of food in the stomach.

When food is swallowed, the branches of the pneumogastric nerves in the throat are stimulated; as a result the pylorus contracts, the cardiac orifice opens in 8 or 10 seconds from the time food starts from the mouth, the pressure in the stomach falls to zero, and the stomach increases in size to enable it to accommodate the incoming food. The closure of the pylorus during swallowing is necessary to prevent the reflux of bile and other matters from the small intestine.

The appetite juice, or psychic secretion, is produced through the action of the pneumogastric nerves, which are reflexly stimulated through the nerves of taste. There is likewise a psychic gastric tonus which causes the stomach to contract when food is taken into the mouth.

The stomach, intestines, and other viscera do not possess the ordinary sensation of pain or touch. The stomach and also possibly the intestine, have the temperature sense and are more or less sensitive to cold and heat.

Pain referred to the abdomen is believed to be really due to the extreme sensitiveness of the peritoneum or lining membrane of the abdominal wall, which is very highly endowed with the pain sense, and when in the state of inflammation is exquisitely sensitive.

The muscular sense is highly developed in the walls of the stomach and intestine. Violent contractions of the muscular walls of the intestine, or cramp, give rise to pain much the same as does muscular cramp in any other part of the body.

Because of the close connection of the duodenum and the colon with the abdominal wall, inflammation and violent contractions of these parts are more likely to give rise to pain than when they occur in other parts.

Stretching is the most efficient means of stimulating the intestinal wall to contraction. This is the cause of the pain of colic.

The introduction of fluid into the colon gives rise to both antiperistaltic and peristaltic waves by distending the colon. If the quantity of liquid introduced is so large as to overstretch the gut, severe colic pains may be induced.

When the sympathetic nerves are stimulated the result is complete relaxation of the entire alimentary tract except the pylorus, ileocecal sphincter and the anal sphincters. Nicotine irritates the sympathetic nerve and thus has the effect to paralyze the pneumogastric nerves, abolishing their action upon the stomach and intestine.

The pain of gastric ulcer is due to inflammation of the lymphatic vessels and glands in the vicinity of the ulcer. In this condition a very weak acid solution may give rise to pain, whereas in a healthy stomach no sensation whatever is produced by a strong solution of hydrochloric acid (.5 per cent).

Great weakness or depression may cause complete suspension of the peristaltic waves of the stomach and intestine so that the food remains stationary. Anger, anxiety, mental or physical distress, may cause the movements of the stomach to cease at once. Cannon observed this in the cat, rabbit, dog, and guinea pig.

The antiperistaltic waves of the colon are abolished by excitement, which may be a cause for the occasional occurrence of sudden diarrhea under this condition.

The excitation of the sympathetic nervous system by emotional excitement may cause cessation of both secretion and motion in the entire alimentary canal.

The tonus of the stomach, which starts digestion, depends upon appetite. Appetite gives rise to hunger, and Cannon has shown that hunger is due to contraction (tonus) of the gastric muscles.

The Normal Intestinal Rhythm.

When at the end of eight hours the unusable residue is pushed through into the colon it is ready to be dismissed from the body and should be dismissed without any considerable delay. The colon possesses no digestive function. It is a waste disposal organ, and when properly trained hastens along the refuse received from the small intestine, together with the various body wastes which are excreted into it, and pushes them out of the body before they have had time to undergo putrefactive changes.

Recent X-ray studies of the colon show that it possesses a controlling mechanism somewhat similar to that which controls the heart. When undamaged by mistreatment it handles the food residues in a wonderfully intelligent and efficient manner. A check valve placed between the small intestine and the colon prevents the reflux of the waste matters from the colon, which is highly important. The rapid transit of the foodstuffs through the small intestine affords no opportunity for putrefactive changes. The small intestine never rests until its undigested residues have all been pushed on into the colon, a task which is practically always completed at the end of eight hours from the beginning of a meal. Fortunately, the movements of the small intestine are wholly independent of the will, and its expeditious action is rarely interfered with by any cause whatever. With the colon, however, the case is different. Whether or not the colon is emptied of its contents depends more or less upon individual whim and convenience.

If evacuation of the bowels at the proper time is neglected, the waste products which are continually being pushed forward from the small intestine, accumulate and the colon becomes filled from end to end and even distended by its undue accumulation. On the other hand, if the colon is permitted to function in a perfectly normal manner, the waste products which reach the center of the colon eight hours after the taking of a meal are by the impetus received by the next meal pushed forward nearly to the point of exit and by the impetus received from the following meal are pushed out of the body.

A moment's thought will show that when this order of things exists the food residues and body wastes are never retained long enough to permit putrefactive changes to occur. For example, if breakfast is taken at 8 o'clock the residue will be dismissed by 10 o'clock P. M. or at the end of 14 hours; the dinner residue will be dismissed soon after rising the next morning or at the end of 17 to 19 hours; and the supper residue will be dismissed after breakfast or at the latest after dinner the next day or at the end of 15 to 20 hours. So long as this happy order is maintained, there is no putrefaction in the colon, no absorption of putrefaction products, and in consequence freedom from biliousness, headaches, lack of appetite, and the long list of miseries which are the natural result of the absorption from the colon of the poisons of various sorts which are always present when constipation exists, that is, when the bowels move but once a day or at less frequent intervals.

The universal use of pills, mineral waters and other means of stimulating the activity of the bowels is the natural result of the abuses to which the colon is subjected by wrong diet, neglect to attend to the call of nature and various other disturbing influences which are almost universally active among civilized people.

Our dogs, cats and other household pets are "house-broken" and in consequence become constipated like their masters who are also house-broken. The poor colon has suffered to an extraordinary degree from the conditions imposed by house dwelling and civilized life. An Arab when offered a good situation in a neighboring city declined for the reason that in the city it was often inconvenient to evacuate the bowels promptly when nature demanded.

A Japanese home provides toilet conveniences for visitors adjacent to the receiving room. A visitor does not hesitate to inquire, if a man, for "the honorable convenient place," or, if a lady, for "the honorable modest place."

The modes of our Western civilization imposes upon us a hypocritical modesty the influence of which is most deadly, and in many different ways.

Constipation is a disease of civilization. Wild men and wild animals do not suffer from this malady, which is perhaps responsible for more human misery, mental and moral disaster, and even crime, than almost any other cause that could be named. This subject will receive further attention in a chapter devoted to the dietetic treatment of constipation.

The Liver

The liver is one of the most remarkable and versatile organs in the body. The weight of the liver, the largest gland in the body, is three and one-half pounds. It contains more than twenty million bile-making cells which together produce every 24 hours 20 ounces of bile. It has been estimated that each cell makes in a lifetime of 60 years, ten drops of bile!

These facts place before the mind at once a vivid picture of the wonderfully delicate structure of this marvelous organ. The liver performs more different kinds of work than any other organ of the body. Here is a brief summary of the chief kinds of work performed by the liver:

1. *The Liver Aids Digestion.*

When food leaves the intestine and enters the portal vein the digestive work is not yet quite completed. It requires certain delicate touches which only the liver can give; hence the portal vein carries to the liver the products of gastric and intestinal digestion and there the digestive work is completed. Levulose or fruit sugar is by the liver converted into glucose or dextrose, the only form in which the body cells can make use of sugar. Galactose, derived from milk sugar, is also converted into dextrose by the liver. The liver converts wastes and surplus protein into ammonia and further converts ammonia into urea. Finally, the liver aids digestion by secreting and pouring into the intestine 20 ounces of bile every 24 hours.

2. *The Liver Stores Food Supplies.*

The sugars of various sorts absorbed from the intestine are by the liver converted into glycogen or animal starch and stored up in its cells, a source of energy to be drawn upon until the supply is replenished by another meal. From moment to moment, as needed, the liver changes the insoluble glycogen back to sugar and pours it into the blood to be sent to the heart and other muscles for use.

The liver also stores up iron. This is particularly true in infancy. The liver of the new born infant contains nearly all the iron that will be required to produce the hemoglobin of the blood until the infant has attained the age of 9 months. This is necessary for the reason that the mother's milk contains but a very small percentage of iron. The livers of guinea pigs store no iron. No storage is required because the guinea pig begins to eat grass which is rich in iron the very day it is born. But milk contains little iron and as the human infant receives little iron-containing food until after it is weaned, its liver is stocked with iron before its birth to furnish the material needed for blood-making during the nursing period.

It is believed that the liver of adults stores iron derived from worn-out red blood cells and utilizes it in the making of hemoglobin for new red corpuscles.

The liver also stores up vitamins, particularly the fat-soluble vitamin, the deficiency of which in foodstuffs causes dwarfing in growth and diseased conditions of the eyes. This interesting fact explains the well known efficacy of cod liver oil in improving certain conditions of bad nutrition. It is now known, however, that butter and cream possess the same value, a fact clinically recognized long ago by sagacious practitioners. Now that the rationale of the use of the unpalatable oil is understood, it ought rapidly to fall into disuse.

3. *The Liver Stores Metallic Poisons.*

Metals, such as lead, which may be found in water which has passed through lead pipes, mercury used as medicine or absorbed by other means, and various other metallic substances found in hard waters and mineral waters are captured, in large part, by the liver. The storing of these foreign substances in the liver more or less cripples it and impairs its functions; hence the liver should be protected against damage from this source.

4. *The Liver Detoxicates Organic Poisons.*

It is the liver which stands between the smoker and death. The liver destroys or detoxicates nicotine and prepares it for elimination by the kidneys. This is true of the numerous poisons absorbed from the colon and the various poisons produced by the body as well as of poisons received through food and drink, such as alcohol, tea, coffee, etc. When the liver has more of this work than it can well perform the blood becomes saturated with poisons and a state of autointoxication is produced. In this condition a person suffers from the symptoms which are commonly known as "biliousness." The indication is not that the liver is inactive but that more work is imposed upon it than it is possible for it to perform.

5. *The Liver Makes Ferments and Hormones.*

These subtle substances are essential for the working of the wonderfully intricate mechanism of the body. Nearly all of the vital changes which take place in the body are the result of the action of activating substances, that is, substances which set in motion vital or chemical changes by their mere presence. Many of these hormones and ferments are known but it is believed that the unknown activating agents greatly outnumber those which are as yet known.

6. *The Liver Makes Bile.*

In the bile are found highly poisonous alkaline wastes. Bouchard showed that the bile is six times as poisonous as the urine. The alkaline substances which the bile contains serve a useful purpose in neutralizing the acidity of the gastric contents which must be neutralized quickly after they enter the small intestine to prevent injury to the delicate mucous membrane of these parts which is not able to withstand the action of acids as is the mucous membrane of the stomach. Bile activates the pancreatic juice which, when it leaves the pancreas, possesses no digestive activity. Bile also emulsifies fats, aids the absorption of fats and other digestive foodstuffs and inhibits or hinders the growth of germs and the production of germ poisons, possibly also serving in some degree to neutralize the poisons produced by certain bacteria in the intestine.

Mastication

Grinding, mixing, spreading, transporting, and discharging are the several mechanical factors involved in the process of digestion. In chewing, the cheeks and the tongue co-operate in keeping the food between the teeth, which by a gradual reduction process grind hard substances to the proper fineness for swallowing. The consistency of the food is tested by the cheeks, the gums, the tongue, and the soft palate. When found imperfectly chewed the food is automatically returned to the grinding surfaces for further chewing. The soft palate, the membranous veil which hangs in the back of the throat, is endowed with a delicate tactile sense which especially equips it for the inspection of the foodstuffs which come in contact with it in the act of swallowing. When properly chewed, much of the food becomes liquid, being dissolved by the saliva and to some extent liquefied by the digestive action of the salivary ferment. The undissolved portion is reduced by thorough mastication to particles not more than one-twelfth of an inch in diameter. It is not uncommon, however, to find in vomited matters masses half an inch or more in diameter, because of insufficient mastication.

The amount of pressure exerted in chewing, when tested with the dynamometer, is found to be surprisingly great, amounting in a person with well developed jaws to as much as 270 pounds when the teeth are brought together with as much force as possible. In the chewing of delicate or friable substances a pressure of not more than one or two pounds is sufficient. Tough meat requires a pressure of 40 pounds to divide its fibers. In the chewing of bread crust the pressure rises to 60 pounds, though when well softened with water or saliva it is easily crushed with a pressure of three pounds.

The act of chewing does more than merely to mechanically divide the food. It promotes the flow of saliva and prepares the stomach for the reception of the food. Chewing of palatable food causes the stomach to contract and causes the gastric glands to pour out the appetite juice which is necessary to start the process of gastric digestion after the food is received into the stomach. If the food is tasteless, or indifferent, mastication has no effect upon the stomach. When food is hurried through the mouth instead of being properly chewed, over-eating is likely to occur as the gustatory reflexes through which the body instinctively makes a selection of foodstuffs suited to its needs have no opportunity to operate.

Spallanzani's Discoveries About Mastication.

Probably many people imagine that Horace Fletcher was the first apostle of thorough mastication; but the fine art of mastication really had a much more ancient origin. To Spallanzani, a man of science who flourished in the eighteenth century (1729-1799) belongs the credit of having been the first to demonstrate the importance of thorough chewing of the food. In his great work on "Digestion," Spallanzani gives an account of experiments which demonstrates the importance of thoroughly chewing the food. Spallanzani was the first to study experimentally the properties of the gastric juice. He made small hollow spheres with perforated sides. Into these he introduced foodstuffs of various sorts, then swallowed the spheres and after they had passed through the body, examined the contents, noting the changes which had been wrought by digestion. By this ingenious method, he also studied the effects of mastication.

We quote his own account of his experiments and his conclusions therefrom from an old work, "The Art of Invigorating Life," by Wm. Kitchiner:

"I took two pieces of Mutton, each weighing 45 grains, and having *chewed* one as much as I used to chew my food—enclosed them in two separate spheres—and swallowed them at the same time—these tubes were voided at the same time—of the masticated meat there remained only 4 grains—of the other there were 18 left.

"The necessity of *Mastication* is sufficiently known—there is perhaps no person who has not, some time or other, suffered from Indigestion, for want of having chewed his food properly. The reason is obvious. Not to mention the saliva which moistens the food, and predisposes it to be dissolved, it cannot be doubted, that when it is reduced to pieces by the action of the Teeth, the gastric fluid penetrates, and attacking it at more points, dissolves it more speedily than when it was whole. This is true of menstrua in general, which always dissolve bodies sooner when they have been previously broken to pieces. This is also the reason why, in other experiments, masticated bread and *dressed* flesh were more readily dissolved than unchewed bread and *raw* flesh. The boiling had made it tenderer, and consequently disposed it to allow ingress to the gastric fluid."

Three-quarters of a century later, the famous Dr. Arbuthnot tells us that "Mastication is a very necessary Preparation of solid Aliment, without which there can be no good Digestion"; and that

"To Chew long, and leisurely, is the only way to extract the essence of our food—to enjoy the taste of it, and to render it easily convertible into laudable Chyle, by the facility it gives to the gastric juices to dissolve it without trouble.

"The pleasure of the *Palate,* and the health of the *Stomach,* are equally promoted by this salutary habit, which all should be taught to acquire in their infancy. * * *

"From 30 to 40 (according to the tenderness of the meat) has been calculated as the mean number of Munches, that solid meat requires, to prepare it for its journey down *the Red Lane;* less will be sufficient for tender, delicate, and easily digestible white meats."

Finke, in his *"Medical Geography,"* published more than a hundred years ago, tells us that,

"Slave dealers are well acquainted with the characteristic signs of perfect Health—any defect of which much diminishes the value of a Slave. The want of a *Tooth* makes a Slave worth two Dollars less.

"*Mastication* is the source of all good Digestion;—*with its assistance,* almost any thing may be put into any stomach with impunity:—*without it,* Digestion is always difficult, and often impossible: and be it always remembered, it is not merely what we eat, but what we digest well, that nourishes us."

Brillat-Savarin, a French advocate and judge who at the time of the French revolution sought refuge in this country, in an interesting work entitled *"Physiologie du Gout,"* calls attention to the importance of mastication, telling us that the foodstuffs "must be comminuted by the teeth, impregnated with the saliva and other gustatory juices, and pressed against the palate by the tongue till the juice so yielded makes a favorable impression upon the gustatory papillæ, and the triturated body received from them the passport necessary to enter the stomach.

"In performing this function, the tongue unites the food in a pulpy mass in the middle of the mouth; and then, supporting itself against the lower jaw, it lifts up its central portion, so that it forms at its root a declivity through which the food slips into the back part of the mouth, where it is received by the pharynx, which, contracting in its turn, propels it into the esophagus, of which the peristaltic motion conducts it into the stomach."

Beaumont a few years later in the epoch making work in which he recorded the results of his "experiments and observations on the gastric juice and the physiology of digestion," made on St. Martin, tells us that "mastication is absolutely necessary to healthy digestion." He adds, "if food is swallowed rapidly, more will generally be taken into the stomach before the sensation of hunger is allayed than can be digested with ease."

The noted Count Rumford, and Sinclair, the famous author of "The Code of Health," likewise advocated thoroughgoing mastication.

The late Dujardin-Beaumetz, of Paris, called special attention to the importance of mastication many years before the advent of Fletcherism. Said this eminent medical teacher,—

"It is not sufficient simply to prescribe a vegetarian regimen, abstinence from alcoholic drinks, and the use of alkaline waters; it is necessary to require of the patient that he give to his meals sufficient time to secure complete mastication of his food. Miahle maintained many years ago that all dyspepsia is the result of insufficient mastication. Without going so far as this, one may say, however, that the presence of badly masticated foods is one of the most frequent causes of gastro-duodenitis. Such foods really act as foreign bodies, which irritate the pyloric region of the stomach and the mucous membrane of the duodenum. The same is true of an excessive quantity of foods. Great eaters are very subject to gastritis. It is necessary, then, to eat rationally and to masticate slowly."

Sir Andrew Clark, physician to Queen Victoria, used to say that since the mouth contains thirty-two teeth, every mouthful of food should receive thirty-two bites.

It is thus very evident that the importance of thorough mastication of the food is by no means a new or a modern discovery, but is simply the recovery of a much neglected truth, the value of which was fully appreciated by our remote ancestors as well as other members of the animal kingdom.

Since 1875 the writer has frequently demonstrated experimentally in public lectures the necessity for thorough chewing of the food to secure the digestion of starch. During this entire period it has been his practice to recommend to his patients the thorough mastication of dry food for the purpose of promoting the health of teeth and good digestion. This practice, in fact, was begun by the writer himself more than 50 years ago as a result of an elementary study of human physiology. Mr. Fletcher certainly did not discover the necessity for thorough mastication. His Fletcherizing movement was a renaissance.

Horace Fletcher's Discoveries.

A really important discovery made by Mr. Fletcher, one which, so far as the writer knows, was quite original with him, consisted in his observation that in connection with thorough chewing of the food there is exercised, through the sense of taste, a remarkable selective function which is closely correlated with physiologic needs.

This discovery of Mr. Fletcher's was one of priceless value, although neither the physiologists nor the world at large have, as yet, begun fully to appreciate its importance. The accuracy of Mr. Fletcher's observation has been checked up by numerous other observers, notably by a very extended and elaborate experiment undertaken by Professor Irving Fisher some years ago, with a group of Yale students.

One of the first things noted by Mr. Fletcher was the fact that when each morsel of food was thoroughly masticated, the amount required to satisfy hunger and sustain the energies of the body was greatly diminished; and Count Rumford, more than a century ago, suggested to the elector of Bavaria that if he would require his soldiers to thoroughly chew their rations, a small quantity of food would be found to "afford more sustenance than a large meal hastily devoured."

Mr. Fletcher's observations went farther and deeper. He noted not only that the total food requirement was lessened, but that there was especially a notable curtailment of certain kinds of foodstuffs, especially those which were rich in protein. This led him to the further discovery that the amount of protein actually needed to meet essential body needs is really very small, only a fraction of that ordinarily consumed. It was this feature of Mr. Fletcher's observations which led him to make his greatest contribution to dietetic progress, which consisted in the enlisting of Professor Chittenden to undertake his historic research for the purpose of determining the minimum protein requirement.

This great experiment, in which a body of soldiers, loaned by the United States government for the purpose, a number of athletes and several college professors served as subjects, was extended over many months, and established beyond any chance for cavil the sufficiency of a ration containing less than half the amount of protein which had previously been considered essential for the maintenance of health and vigorous activity. Chittenden's results have been seen abundantly confirmed by other investigators.

Sherman showed (*Journal of Biological Chemistry*) by 67 experiments on men and 42 experiments with women, that the average amount of protein required per day is .635 grams per kilogram of body weight, which is equivalent to .29 grams (4.5 grains), or one and one-sixth calories per pound of body weight. This will give to a man weighing 150 pounds and requiring 2,500 calories 175 calories of protein instead of the 250 supplied by the Chittenden standard.

The Japanese have for generations "lived and thrived on a daily ration noticeably low in its content of protein" * * * and "generations of low protein feeding, with the temperance and simplicity in dietary methods thereby implied, have certainly not stood in the way of phenomenal development and advancement" (Chittenden).

Mr. Fletcher not only instigated the research conducted by Professor Chittenden, but, according to his own statement to the writer, he shared the expense of the work to the extent of several thousand dollars.

But Mr. Fletcher's observations went still further. He discovered that thorough mastication of the food gradually lessened, and, after a time, eliminated the relish for such unwholesome things as mustard, pepper, and other hot condiments. Even wine, when taken very slowly, so that each sip was retained in the mouth until the last vestige of flavor was exhausted, lost its attraction, and a very small amount sufficed to satisfy the wine craving, which finally disappeared, together with the craving for tobacco.

Professor Fisher's experiments confirmed the observations of Mr. Fletcher in a very striking manner. A group of young men, consisting of half a dozen students from the different departments of Yale University, were furnished with a cook and caterer, and given *carte blanche* as to the constituents of their bill of fare, in both quality and quantity. In other words, they were allowed to eat anything they liked and as much as they liked, the only stipulation being that they should thoroughly chew each morsel of food. After a few months, it was found that the young men had practically discontinued flesh meats of all kinds. When asked why they had done so, the unanimous reply was, "The long chewing of the meat made it distasteful to us." The only ones who continued the use of meat were one or two students who had been less conscientious than the others in obeying the instructions with reference to thorough chewing.

Mr. Fletcher established the fact that the sense of taste, properly trained, is a competent guide as regards both the quantity and the quality of the food required. It must be remembered, however, that the nerves of taste can exercise this function only when thorough mastication gives them an opportunity to fully examine the food and to completely appreciate its sapid properties. The experiments of Evvard with pigs and of Osborne with white rats have shown that animals, when left to themselves, are instinctively led to make the wisest selection of foodstuffs, and when thus thrown upon their own responsibility, flourish to a degree unprecedented under human dietetic management.

It is unbelievable that the human race has from the beginning been inferior to animals in the ability to select the foods necessary to meet nutritive requirements; but somewhere on the long road from our prehistoric origin down to our present degenerated state, this food-regulating instinct has been to such a degree obliterated or blunted that, until Mr. Fletcher made his interesting discovery, it was supposed to be lost. Indeed, it cannot be denied that man's best performance in this line is highly inferior to what is seen in lower animals, for the wolf, the monkey, and wild animals generally, and to a very large extent domestic animals, determine the wholesomeness of food by the senses of smell and taste; but in man this power is so nearly lost that he derives comparatively little assistance from his senses in the selection of food with reference to its healthful properties. It is quite possible, however, that future investigations may show that the olfactory and the gustatory nerves which are closely associated in the sensations we call taste, may be the seat of wonderful reflexes through which the body may govern the intake of new material so as best to meet its essential needs.

And so it appears that man is not altogether left without a guide and compass in relation to his nutritive needs. He still possesses a mentor which, though speaking with a greatly attenuated and weakened voice, is nevertheless able to make itself heard, if he is only willing to listen attentively. And to *listen*, one must take care to chew each morsel of food not simply until it is fine enough so that it can be swallowed conveniently, but until the major part of its flavor has been set free and appreciated. Anyone who will take his food in this manner, will have little occasion to consult diet specialists or call for professional aid of any sort; for there is no one thing which comes so near to being a panacea for all gastric ills and nutritional disorders as thorough mastication of the food and careful attention to the natural promptings of a disciplined and intelligently studied sense of taste.

In the journal, "Good Health," as well as in numerous books, the writer has advocated the importance of mastication, for more than forty years, but the world is certainly indebted to the late Mr. Horace Fletcher for attracting public attention to mastication as a means of promoting good nutrition and initiating a popular movement in behalf of chewing reform.

It was for the purpose of encouraging patients to masticate their food thoroughly that the writer many years ago (1895) was led to undertake experiments which resulted in the invention of toasted wheat flakes, corn flakes, and other toasted cereal flakes. For many years it was the custom at the Battle Creek Sanitarium to place at the plate of each patient a small bowlful of wheat flakes which he was expected to eat dry before taking any other food. The purpose of this was to educate patients in the art of mastication and to develop the habit of thorough chewing and insalivation of the food.

Thorough mastication of the food should be habitually practiced as an important measure for the preservation of the teeth, to insure good digestion and as a means of aiding the regulation of the food intake through the gustatory nerves, as has been already explained.

Special Indications for Thorough Mastication.

Special pains should be taken to masticate the food to the extent of reduction to a soft pulp in the following cases:

1. Achylia, a condition in which the stomach has ceased to make hydrochloric acid so that the action of the gastric juice is suspended. It is true that in these cases salivary digestion continues so that the starch may be more completely digested than in the normal stomach. Nevertheless, the food is no longer subjected to the solvent action of the gastric juice, and hence if the food enters the stomach in large lumps, these masses will be pushed on into the small intestine and disturbances of intestinal digestion will be likely to result. It must be remembered, also, that in cases of achylia the duration of gastric digestion is greatly reduced, the food leaving the stomach often in two or three hours instead of being retained for four or four and a half hours. It is evident, then, that very thorough mastication is required in cases in which the normal gastric acid is not present.

2. In cases in which the operation of gastro-enterostomy or the Polya or any other reconstructive operation has been performed upon the stomach, thorough mastication of the food is highly important, for such a stomach is more or less crippled at the best, and mouth digestion should be advanced as far as possible so as to lighten the work of the stomach.

3. In cases of obesity, thorough mastication is important as a means of limiting the amount of food eaten. In diabetes, in which the food is necessarily limited, thorough mastication should be enjoined upon the patient as a means of securing satisfaction of the appetite without a large intake of food. In bulimia (excessive appetite), epilepsy, and in persons subject to hiccough and aerophagia, thoroughness of mastication is necessary.

4. Prolonged mastication is also a useful aid to peristalsis and should be practiced by persons subject to constipation. Hertz, Case, and others have shown that the food residues move along in the colon four times as rapidly during the taking of a meal as during the intervals between meals. In other words, mastication of food seems to set the whole alimentary canal in motion, especially increasing the activity of the colon, which is needed in constipation.

5. Efficient and prolonged mastication of the food is also

highly important in cases in which the gallbladder has been removed. The reason for this is that by prolonged mastication the food will enter the stomach more slowly and hence will pass out into the small intestine more slowly. This is important for the reason that when the gallbladder is removed the liver is not able to store up any considerable quantity of alkaline bile with which to neutralize a large quantity of highly acid material coming from the stomach within a short time.

6. Very thorough mastication of the food is required whenever it is necessary to prescribe a diet of dry or solid food.

Professor Strümpell made an experiment for the purpose of determining the influence of imperfect mastication upon the digestion and absorption of protein. He swallowed half chewed a plate of boiled lentils. He found that only 40 per cent of the nitrogen was absorbed, or less than half the amount that should have been taken up.

According to Gautier, the same is found to be true of other vegetables and also with bread when eaten in too soft a state, and when care is not taken to secure a thorough and abundant mixture of saliva.

When the Food Should Be Little Chewed.

While the thorough mastication of food is usually essential to good digestion and good health, there are conditions in which much mastication is to be avoided, the food being taken in liquid or puree form and so needing no mastication to prepare it for swallowing.

1. It is well known that the chewing of food stimulates the formation of gastric acid. It is evident that in cases in which an excess of acid is formed much chewing will tend to aggravate the difficulty and hence hard and dry foods which need thorough chewing to prepare them for swallowing should be avoided.

2. In cases of gastric and duodenal ulcer, also in cases of gallbladder disease accompanied by pyloric spasm or "hunger pains," chewing should be avoided.

3. Chewing is also to be restricted in cases of gastric hypersensitiveness in which pain follows eating of solid foods although the gastric juice contains no excess of acid as shown by tests after a test meal. Soft foods should be eaten.

Horace Fletcher's Fatal Mistake.

Mr. Fletcher was right in his estimate of the value of thorough mastication of the food, though he was wrong in supposing much chewing to be a rule of universal application.

Mr. Fletcher somehow hit upon the idea that it was essential that all the food should be made liquid *in the mouth,* and that any part of the food which could not be reduced to liquid form *in the mouth* should be discarded. This idea was not included in his discoveries about the discriminating power of the gustatory nerves, and was not a legitimate inference from the demonstrated value of thorough chewing; it was a pure supposition or hypothesis, or perhaps we should say mere conjecture. But Mr. Fletcher attached to this assumption all the importance of a demonstrated truth, and dwelt much upon it. This most unfortunate error was his undoing. It led him to avoid foodstuffs which contained insoluble substances, such as the seeds and skins of fruits, and to restrict his dietary to soft foods, soups, purees, and liquid foods.

One result of the use of soft foods which required little chewing was rapid decay of his teeth. On his various visits to Battle Creek, he was constantly in the hands of a dentist, who told the writer more than once that he was astonished at the bad condition in which he found Mr. Fletcher's teeth, and at the rapidity with which they were undergoing decay.

But another and a still more serious result of the soft diet, wholly free from indigestible elements, was a most obstinate constipation. Mr. Fletcher told me on several occasions that his bowels moved only once or twice a week.

After a time he came to look upon this chronic constipation as a great advantage, and as proof of the virtue of extra mastication. He argued that thorough chewing secured such perfect digestion and such complete absorption and utilization of the food that there was left no residue for germs to act upon, and so was a sort of sterilizing process. As proof of this, he offered the fact that the small hard stools which he dismissed from his colon at intervals of several days were almost odorless.

Mr. Fletcher overlooked the important facts that the bile and mucus of the intestine are highly putrescible materials and that the odorless character of dry fecal masses is the result of the nearly complete absorption of skatol and indol during their long retention in the colon. This was proven to be true in his own case. A mild laxative gave rise to a stool which greatly astonished him by its loathsomeness.

Mr. Fletcher was so carried away with this idea that for some time, at least, he made quite a hobby of it, and it came to be generally understood that infrequency of bowel movements was a regular part of the Fletcher regime, or "Fletcherism," as he preferred to call it.

There is reason to believe that at last Mr. Fletcher saw his error and endeavored to correct it, at least so far as his own habits were concerned. But, unfortunately, it was too late. The mischief had been done. His vital stamina and resistance to disease had been exhausted by many years' struggle against colon poisons, and he died of chronic bronchitis, doubtless due to the toxemia from which he had long suffered.

Mr. Fletcher's experience inculcates the lesson that there is no simple panacea for the ravages of time. Long life cannot be made sure by any simple formula. Thoroughgoing obedience to all the laws of "biologic living" is the price which must be paid. "For whosoever shall keep the whole law, and yet offend in one point, he is guilty of all," says Holy Writ.

Hunger

Hunger appears to be a very universal sensation. Minute vegetable organisms, such as the swarm cells of spore-producing plants, according to Lister, may behave very much like hungry animals, swallowing microbes and digesting them with avidity while resting, then swimming off to find more food.

People who eat several times a day often never experience the sensation of real hunger. Hibernating animals have no hunger. Insects are not hungry during the winter. The myriads of salmon which ascend the Columbia River are said never to eat, notwithstanding the great exertion in swimming hundreds of miles up stream. On the other hand, birds appear to be hungry all the time; at least they eat continually, though food is always found in their crops. The caterpillar does nothing but eat and defecate; but in certain species, after the caterpillar becomes a butterfly, it never eats at all. In some insects, according to Faber, there is no provision for hunger, the digestive organs being lacking in the fully developed insect.

Hunger may become so intense as to cause great lassitude, weakness, nervous irritability, and even headache and nausea. In extreme cases fainting may occur.

The seat and cause of hunger have been the cause of much research and discussion by physiologists for centuries. Haller thought the sensation of hunger to be caused by the grinding or rubbing together of the folds of the mucous lining of the stomach, due to contraction of its walls, observing that in a hungry man "the stomach is always contracted" (pinched). In this opinion the sagacious scientist came very near the truth as we shall see later. Darwin, on the other hand, thought hunger to be due to the absence of contractions in the stomach. Beaumont regarded hunger as the result of "a distension of the gastric vessels" or glands with gastric juice. Ewald considers hunger as purely a psychic sensation due to stimulation of the hunger center by an impoverished state of the blood. Boldyreff discovered, in 1905, by placing inflated balloons in the stomachs of starving dogs, that strong contractions of the stomach occurred at quite regular intervals. In 1912, by similar experiments upon human beings, Cannon proved that these contractions are the cause of hunger. Each contraction of the stomach gives rise to a hunger pang lasting about half a minute. The contractions may be repeated rhythmically during 15 minutes to an hour or even longer in extreme hunger, and in very intense hunger the contraction may become continuous.

There are two elements in hunger, one relating to the stomach itself, the other relating to the body as a whole.

A very strong sensation of hunger is accompanied by a feeling of emptiness which may affect the whole abdomen. This may be relieved or temporarily abolished by pressure upon the abdominal wall. The starving Indian tightens his belt to relieve his discomfort.

Appetite.

There is a definite distinction between hunger and appetite. One may experience hunger without appetite, a not uncommon experience, but appetite without hunger is the daily experience of those who eat desserts at the end of a full meal. Hunger is referred to the stomach, whereas appetite is nearly always referred to the mouth and throat. One's mouth may water in the presence of savory viands although the sensation of hunger is not felt. Hunger, as Cannon has shown, is due to actual contractions of the gastric walls and is not felt in the absence of these contractions; but appetite is a product of the memory of pleasant sensations of taste and smell associated with eating.

Satiety.

Satiety is the state of satisfaction resulting from taking sufficient palatable food to satisfy hunger and slightly distend the stomach. An Irish laborer, accustomed to a diet of potatoes and buttermilk, is not satisfied with a meal consisting of concentrated food less in bulk, even though the actual amount of nourishment taken may be much greater. Fats more than any other foodstuff contribute to the sense of satiety. A very small amount of fat often satisfies the appetite. Many persons find it difficult to eat fat in any but very small quantity on this account.

Nausea.

Nausea is in some respects closely akin to hunger; in fact, hunger and nausea are sometimes felt simultaneously. In nausea, however, there is absence of true hunger pangs. Violent contractions occur in the pyloric region, accompanied by a dilatation of the cardiac orifice,—a pressure pain sensation and sinking feeling, headache, perspiration, usually giddiness and often great prostration.

Hunger in Infants.

In adults, hunger usually occurs four to six hours after a full meal. In an infant, hunger occurs in two or three hours. The hunger contractions of the stomach are much stronger in young persons than in those advanced in years.

The Hunger of Starvation.

Hunger contractions appear to be increased in vigor by starvation. Carlson states that in himself this change was very marked and lasted for some time after a five days' fast. He also suggests that this effect may be analogous to the general rejuvenating effect of starvation in certain animals, and even intimates that an occasional period of starvation may exercise a beneficial influence in the prolongation of life and in renewing vigor and capacity for work.

Hunger During Sleep.

It is a curious fact that while the "tone" of the general muscular system, the blood vessels, the bladder, and other muscular parts decreases during sleep, this is not true of the hunger contractions of the stomach, which not only continue in full vigor but even may become so strong as to cause awakening from sleep in adults as well as in children and dogs.

Mental and Nervous Influence on Hunger.

Ordinary mental processes do not influence hunger, but the sensation is temporarily abolished by fear, anger, joy, and perhaps other emotions.

When a starving person sees or smells appetizing food, the hunger pangs are more intensely felt, although the hunger contractions are not increased.

Hunger contractions have been proven to be due to the local nervous mechanism rather than to the pneumogastric or sympathetic nerves. Even when completely isolated from the central nervous system, the stomach makes hunger contractions.

Chewing or tasting palatable foods diminishes hunger contractions. Movement of the jaws, when the mouth is empty, has no influence upon the hunger contractions; but chewing gum, paraffin, even straw or wood, may lessen hunger. Hunger is temporarily relieved by very small quantities of food.

Absence of Hunger.

Hunger contractions differ from the movements of the stomach during digestion in the fact that the movements of the stomach during digestion are almost wholly confined to the pyloric region, while hunger contractions involve the left portion of the stomach.

Hunger, when present, may be diminished by taking water into the stomach, particularly ice water. Small pieces of ice, when swallowed, have a decided effect in lessening hunger.

Hunger may also be temporarily abolished by passing a tube into the stomach. Rectal feeding decreases hunger.

Strong acid solutions have the effect to diminish the hunger contractions, as do also strong alkaline solutions.

The introduction of air into the stomach produces no effect.

Smoking lessens hunger by stimulating the nerves of the mouth. Any stimulus applied to the mouth has a similar effect.

In nausea the cardiac orifice and the fundus of the stomach are completely relaxed; hence hunger is necessarily absent.

Pressure over the stomach by means of a belt lessens the hunger sensation but does not abolish it. A smaller amount of food is required to appease hunger when a belt is applied before the meal. This fact suggests a method of aiding control of the appetite in cases in which it is necessary to restrict the amount of food taken, as in obesity. The belt diminishes the amount of food necessary to appease hunger by preventing the expansion of the abdominal wall which takes place simultaneously with the receptive relaxation of the stomach.

Absence of Hunger in Disease.

The partial or complete absence of hunger and appetite is common in cases of neurasthenia and hysteria. Absence of appetite is also a frequent result of constipation, especially when the tongue is coated. In such cases there might be hunger without appetite. The absence of hunger in fever has been shown to be associated with the absence of hunger contractions.

Appetite is less in advanced age than in youth, for the reason that the hunger contractions are less vigorous.

Increase of Hunger in Disease.

In bulimia, hunger is not appeased by eating, or reappears very shortly after a full meal; if food is not taken, headache, weakness, and prostration develop just as in a normal person suffering from extreme hunger. This symptom, which frequently occurs in Addison's disease, may also appear in connection with various nervous disorders. The hunger of bulimia usually appears very suddenly and it may be satisfied or even changed to nausea by a few mouthfuls of food. In these cases there is doubtless an abnormally irritable condition of the stomach. The application of the moist abdominal bandage, accompanied by a hot pack over the stomach, is a valuable means of relief in these cases.

"Hunger pains" are simply the severe gastric pains which appear when the stomach is empty or within 3 to 6 hours after a meal in persons suffering from ulcer of the stomach or duodenum or disease of the gall bladder. These pains are due to contractions identical with normal hunger pangs, but painful because of the inflammation or other diseased condition present or because of their intensity. In marked hypersecretion, or hypersensitiveness, the pain may be almost continuous. The pain usually disappears promptly on the taking of food.

The pain of gall bladder disease may be due to hunger contractions or to contractions of the gall bladder, which may give rise to pain closely resembling the hunger pains of ulcer. Contractions of the gall bladder are greatly increased during normal digestion and naturally must be exaggerated in cases of hyperacidity of the gastric juice, as are the contractions of the stomach.

Hunger contractions have been shown to be absent in gastritis, tonsilitis, influenza, and colds. Food taken under such conditions sometimes gives rise to nausea. Hunger contractions are shown to be absent in dogs suffering from infection and pneumonia.

Modifications of Hunger.

Exposure of the skin to cold, as in cold bathing, produces shortly afterwards an increase of hunger contractions. This accounts for the beneficial effects of the cold morning bath in producing a readiness for breakfast. This effect is analogous to the well-known influence of cold water applied to the skin in producing contractions of the bladder. Vigorous muscular exercise also increases hunger contractions. A cold bath, followed by a brisk walk, is the best appetite stimulant with which the writer is acquainted. The injection of the blood of a starving dog into the veins of a normal dog increases hunger contractions in the latter. A similar effect was produced by injecting into healthy dogs, blood from an animal suffering from experimental diabetes. Profuse hemorrhage may give rise to hunger contractions. Certain drugs, as pilocarpin and pituitrin, increase hunger contractions, while morphin and adrenalin produce the opposite effect.

Hunger is increased by external cold and decreased by external heat, a characteristic in which it resembles pain sensations. Physiologic experiments show that cold increases nerve sensibility while heat diminishes the same.

Bitters.

Bitters taken into the mouth diminish the hunger contractions, as do other stimulants applied to the oral membrane. It is thus evident that bitters do not increase appetite. It is equally well known that they do not increase but actually diminish the secretion of gastric juice. The only means known which can be relied upon for increasing hunger, appetite, and digestive power are a moderate diet, out-of-door life, exposure to sunlight and cold air, cold baths, and muscular exercise.

THIRST

The sensation of thirst is referred to the mouth and throat. Like hunger, thirst is primarily due to changes in the blood. The blood normally contains 78 per cent. of water. This per cent. is decreased by the addition of solids, such as chlorid of sodium, sugar or the products of digestion. Water is demanded to restore the blood to its normal state. This nice balance between water solvents and solids in solution is maintained by an automatic mechanism, and thirst is the signal of the necessity for adjustment.

When water is absorbed into the blood, the excess is at once removed by the kidneys or skin. The volume of the blood, as well as its composition, is nicely regulated by an automatic mechanism. An intake of water prompted by the sensation of thirst is almost immediately followed by an output of water through the kidneys or skin.

It is well known that thirst is induced by profuse perspiration resulting from exercise or exposure to heat, by the use of food containing considerable quantities of salt and by the use of alcohol and various other drugs. Fever also creates a demand for water, which is now recognized to be essential as a means of aiding Nature in her efforts to bring about recovery, although less than a century ago the use of water was forbidden to fever patients. At the present time, water externally and internally, is recognized as, next to rest, the most important of all means of combating fever.

While it is perhaps possible for a person to drink even pure water in excess of his needs, and possibly to his actual injury, there is no doubt that the opposite fault is by far the more common. It is probable that the average individual would be very materially benefited by doubling the amount of his water intake; that is, water taken in the form of a beverage. Many persons drink only at meals, except perhaps during a few of the hottest weeks of summer.

Persons who suffer from autointoxication and whose tongues are usually thickly coated, are particularly likely to neglect water-drinking, greatly to their detriment. Such persons often do not experience the sensation of thirst except when a great loss of water occurs through vigorous perspiration.

The lack of appetite for food, very common in such cases, is very frequently acompanied by lack of thirst, even when the need of water is as great or even greater than the need of food. The absence of the thirst sensation may be due to a sort of paralysis of the thirst center, just as the lack of hunger may possibly result from a like failure of the hunger center. In such cases, the patient must be required to eat, even though he feels no desire for food; and in like manner he should be required to drink freely, even though the sensation of thirst is not experienced. Since it is sometimes very difficult to induce the patient to drink any considerable amount of water at any one time, he should be asked to drink small quantities, from an ounce to three or four ounces, very frequently. An ounce every twelve or fifteen minutes, or four or five ounces every hour when not asleep, will not exceed the needs of the body.

Air Hunger.

While oxygen is not usually included among foodstuffs, it is really as much a food as is water, and without its active agency, all vital activity would cease. Oxygen supports the vital combustions of the body just as it supports the combustion of wood, oil, and other fuel in our stoves and furnaces. The ordinary air contains a little more than one-fifth (21 per cent.) its volume of oxygen. This amount is more than is needed in ordinary respiration, which requires only about 14 per cent. of oxygen; but during violent exercise a considerably increased consumption of oxygen occurs, and at elevated altitudes where the air is much rarefied, the amount of oxygen is diminished. The extra six per cent. of oxygen which the air contains is evidently a factor of safety to provide for these emergencies.

The body may suffer air hunger through receiving too little oxygen in several ways:

1. By an insufficient amount of oxygen in the air, as when the air contains a large amount of carbon dioxid, displacing a part of the oxygen, which occasionally happens in connection with certain industries, as in the burning lime.

2. A deficient intake of air, as when the chest is confined or the air passages obstructed.

3. Slowing of the circulation of the blood so that the carbon dioxid of the blood is not thrown off and the oxygen taken in with sufficient rapidity.

4. A deficient amount of hemoglobin in the blood, as when the red cells are diminished in number as in anemia.

5. When the hemoglobin of the blood, which carries oxygen, is damaged as in carbonous oxid poisoning, so that it does not give up its oxygen readily.

While oxygen is carried by the red cells, it is afforded to the tissues by the plasma or watery portion of the blood. The plasma absorbs the oxygen from the red cells and passes it on to the tissues. The amount of oxygen contained in the plasma is usually small, only about one-fortieth that found in the red cells, but it may be increased by breathing pure oxygen to as much as seven times the normal amount. In this way the plasma may in emergency be made to take the place of the blood cells. For example, a frog from which all the blood is removed, being substituted by a saline solution, lives and breathes in a perfectly normal way in an atmosphere of pure oxygen.

When the supply of oxygen is greatly diminished, giving rise to cyanosis, relief should be obtained as quickly as possible by supplying oxygen. A delay may result in so great an injury to the nervous system that later efforts may fail when more prompt action would have been successful.

It should be remembered that rapid breathing does not necessarily mean an increased supply of air to the lungs. Very rapid breathing is likely to be shallow breathing. The deeper parts of the lungs are not emptied. If the patient is not able to breathe deeply he should be assisted by artificial respiration or by rhythmic compression of the lower part of the chest or pressing up against the diaphragm from below. A peculiar form of respiration, known as Cheyne-Stokes' breathing, indicates failure of the respiratory center and the necessity for giving inhalations of oxygen.

The inhalation of oxygen is always indicated when there is cyanosis or rapid breathing. This condition may exist as the result of extreme anemia. Rapid respiration is sometimes noted in cases of diabetes. In all such cases oxygen may be inhaled by means of a stream of oxygen passed into one nostril through a soft rubber tube, by means of a mask placed over the nose and the mouth of the patient, or better, by means of a respiratory chamber.

In the *British Medical Journal* of March 6, 1920, Meakins shows that in normal individuals the blood contains about nineteen-twentieths as much oxygen as it is capable of holding; in other words, lacks five per cent. of being completely saturated. In pneumonia and conditions of cyanosis the under-saturation may amount to as much as 18 per cent. By causing the patient to breathe pure oxygen, the under-saturation, even in pneumonia, may be reduced to three per cent.; in other words, the blood of such a patient may be made to hold and carry even more oxygen than the blood usually carries in health. This fact shows the importance of oxygen inhalation in pneumonia. This measure should not be left for use as a last resort when the patient is cyanotic and nearly ready to die, but should be used as the best known means of preventing the development of dangerous and critical conditions.

The Energy of Food — The Calory

Life involves constant change of substance and expenditure or loss of energy. The function of food is to supply energy and to keep the resources of the body from becoming exhausted. All energy is convertible into heat. For this reason, the amount of heat into which any form of energy may be converted is taken as a measure of energy. There are two kinds of heat units in use: The British thermal unit (B. T. U.) is the amount of heat required to raise one pound of water one degree F. in temperature. The more modern unit, devised by the French, is the amount of heat required to raise one kilogram (2.2 pounds) of water, one degree Centigrade (1.8° F.) in temperature. This unit is known as the calory.

One calory is equal to four B. T. U. 's ($2.2 \times 1.8 = 3.96$): that is, the amount of heat required to raise the temperature of four pounds of water 1° F.

The equivalent of one calory in mechanical work is approximately one and one-half foot tons (3,088 foot pounds). Eleven calories are approximately equivalent to one horse power minute.

The Energy Output of the Body and the Work Equivalent of Food.

The body, like a locomotive, is a machine. It is a mechanism which is capable of transforming the potential energy of food into the dynamic energy of work. Considered from an economic standpoint, the animal body is superior to all other mechanisms, since it transforms fuel into work with less loss than any machine which human ingenuity has ever constructed. For example, in the case of the steam engine not so much as one-fifth of the energy of the fuel can be utilized under the best conditions, and ordinarily the proportion of energy utilized is much less than this. In the case of the human machine the relation of food-fuel to energy production is three to one or even as low as two and one-half to one.

It is to be remembered, however, that a considerable amount of energy is required to carry on the internal work of the body.

For example, in a resting man the heart utilizes about 10 per cent. of the total energy intake in forcing the blood through the circulation; the chest muscles in maintaining the movement of air through the lungs consume 20 per cent. of the total energy; 10 per cent. is utilized in the work of digestion and in gland action; 30 to 50 per cent. of the total energy intake is required to maintain the muscle tonus or tension, a rapid rhythmical contraction (16 to 20 per second) whereby bodily heat is maintained; 20 to 30 per cent. is consumed in other vital work.

It is highly important to note that even when a person is in a state of complete rest, as much as one-half of the total energy expenditure of the body may be consumed by tension under the influence of worry, fear, nervousness or excitement of any sort. This form of energy expenditure may be increased to many times the normal amount, which explains why a person becomes tired, even to exhaustion, while simply waiting, and why a worried person or a harried animal cannot be made to gain in flesh, and emphasizes the importance of complete rest as a condition favorable for increasing the body weight.

The amount of energy expended in a state of complete rest is termed the base ration. This for the average person amounts to about 25 calories per kilogram of body weight, or a little less than 12 calories per pound of body weight. This estimate supposes that the body weight is approximately the normal weight for a person of a given height, which may be determined by reference to the proper table (p. 100).

Vital Work—Metabolism.

The various forms of vital activity carried on in the body, especially the intimate cell activities on which all bodily functions depend, are collectively known as metabolism. The vital work, or metabolism, which has for its purpose the building up of the body or storing up energy, is known as constructive metabolism, while the vital work which involves the breaking down of tissues and the consumption of energy, is known as destructive metabolism. In childhood and youth, constructive metabolism is highly active, resulting in growth or increase in both height and weight.

In adult life, after development is completed, constructive metabolism has for its purpose the keeping of the body cells and tissues in repair, and the maintenance of the body weight by the making good of the losses which result from work.

Plants work as well as animals. Bonnier has shown that peas in germinating produce about five calories of heat a day for each gram of weight.

Experiments made by Langworthy and Milner show that during the ripening process bananas produce heat at the rate of about one-half calory per hour per pound. The heat is produced by the destruction of carbohydrates.

But the most extraordinary example of metabolic activity in the vegetable world is to be seen in the work of the nitrifying bacteria of the soil. Muntz and Laine have shown (Burnet) that these organisms working under the most favorable conditions in a specially prepared peat bed an acre in area and 6½ feet thick may produce 60 tons of nitrate daily. In doing this, they would consume fourteen times as much sugar or carbohydrate, an expenditure of energy amounting to more than 3,000,000,000 calories in twenty-four hours.

Destructive metabolism is continually going on in the body, but is most active during muscular work and least active during sleep.

All animals, even plants, require periods of rest, during which destructive metabolism is diminished to such a degree that constructive metabolism is in the ascendency so that losses of energy may be made good. When a person is deprived of sleep, even for a few days, the rapid loss of strength and weight are clear indications of the loss and injury which the body sustains from continuous destructive metabolism and of the beneficent function of sleep. Plants grow most rapidly during the night.

Metabolism During Rest.

During complete rest, even sound sleep, the body cells are at work. The heart continues to beat, the lungs empty and fill, the bodily heat is maintained; digestion, liver action, bile formation, the secretions of the kidneys, skin and other excretory glands continue,—all of the general life functions are carried on as during the waking hours, though less actively. The heart uses in twenty-four hours about one-tenth of the total energy output of the body, consuming one calory of energy for each 400 beats, equal to the lifting of 720,000 foot pounds in twenty-four hours. The heart is able to do this enormous amount of work because each period of intense work is followed by a longer period of rest.

TABLE II.

Table showing the Number of Calories Required according to Height and Weight When the Body is in a State of Complete Rest (Basal Metabolism).

Height in	Weight in Pounds																
In.	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220	231
80	....	....	....	....	....	....	1735	1801	1858	1914	1971	2027	2084	2131	2178	2225	2273
78	....	....	....	....	....	1631	1697	1763	1820	1877	1933	1990	2046	2093	2141	2188	2235
76	....	....	....	1471	1537	1603	1669	1735	1792	1848	1905	1961	2009	2056	2103	2150	2197
74	....	....	....	1443	1509	1575	1641	1697	1754	1811	1867	1924	1971	2018	2065	2112	2159
72	....	....	....	1405	1481	1547	1613	1669	1726	1782	1839	1886	1933	1980	2027	2075	2122
70	1122	1207	1282	1377	1443	1509	1575	1631	1688	1745	1801	1848	1895	1943	1990	2037	2084
68	1103	1188	1263	1348	1414	1480	1537	1594	1650	1707	1754	1801	1848	1895	1943	1990	....
66	1075	1160	1235	1320	1386	1452	1509	1565	1622	1679	1726	1773	1820	1867	1914	1952	....
64	1056	1141	1216	1292	1358	1414	1471	1528	1584	1631	1679	1726	1773	1820	1867	....	....
62	1028	1113	1188	1254	1320	1377	1433	1490	1547	1594	1641	1688	1735	1782	....	....	....
60	1000	1084	1160	1226	1282	1339	1396	1452	1509	1556	1603	1650	1697	....	....	....	....
58	971	1056	1131	1198	1254	1311	1367	1424	1472	1518	1565	1613	....	....	....	....	....
56	943	1028	1103	1169	1226	1282	1339	1386	1433	1481	....	....	....	....	....	....	....
54	915	1000	1075	1132	1188	1245	1301	1348	1395	....	....	....	....	....	....	....	....
52	896	981	1047	1103	1160	1216	1273	1320	....	....	....	....	....	....	....	....	....
50	877	952	1018	1075	1132	1188	1235	1282	....	....	....	....	....	....	....	....	....
48	858	924	981	1037	1094	1150	1197	....	....	....	....	....	....	....	....	....	....

For intermediate weights the number of required calories may be calculated by adding 7 calories for each additional pound of body weight, for weights between 55 and 110 lbs.; 5½ calories for each pound between 110 and 154 lbs.; and 4½ calories for each pound above 154 lbs.

P. S.—Based upon the table of Du Bois and Du Bois.

Metabolism during sleep is greater after severe effort because of increased muscular tension. The sleep metabolism must also be greater in a person sleeping amidst noises even though the sleeper is unconscious of the noise.

Basal metabolism rises during the day, being one-seventh more than during sleep in the morning and nearly a quarter more than during sleep in the late afternoon.

Metabolism must be increased during restless sleep and exciting dreams, accompanied by perspiration and followed by exhaustion.

The Source of Animal Heat.

One of the most remarkable phenomenon connected with the life of a warm-blooded animal is the maintenance of its temperature at a definite point, with little variation irrespective of external temperatures, which may be either considerably above or considerably below that of the body. The normal temperature of the interior of the human body is constantly maintained at about 100° F., though the temperature if taken in the mouth is found to be a little less than 98.4° F.

The body is constantly losing heat through contact with the air, through the breath and the skin. The body loses heat even when the temperature of the surrounding air is above that of the body, through the evaporation of perspiration from the surface. The amount of heat lost by the body depends upon the amount of skin surface, and is regulated by the blood supply to the skin and the excretion of sweat. The amount of heat lost by the body in twenty-four hours is about 2500 calories, which is equivalent to the amount of heat which would be produced by the burning of three-quarters of a pound of coal or a cube of hard wood 4½ inches square or ten ounces of oil.

In the air at a temperature of 86° F., the loss of heat from the body occurs at practically the same rate as that by which it is produced, so that no clothing is required for warmth. It is for this reason that the natives of certain tropical climates wear little or no clothing; or, if clothing is worn, its purpose is to protect the body from the heat of the sun rather than for warmth. This neutral air temperature of 86° F. is the usual temperature of the air surrounding the body underneath the clothing.

The amount of food required by an individual daily, when at rest, depends largely upon the amount of heat lost, and since this depends upon the body surface, it is important to know the body surface for persons of different heights and weights. Various formulae have been developed by which this may be determined in individual cases, but the most convenient method is to refer to a table which has been prepared by Dubois. The accompanying table II, based upon that of Dubois (Lusk's "*Science of Nutrition*,") shows the surface for persons of different heights, from four feet to six feet eight inches, and from a weight of fifty-five pounds to two hundred and thirty-one pounds.

The heat of the body may be regarded as a waste product of metabolism, or cell work. It is for the most part a by-product of muscular work. When a person is at rest, the temperature is maintained by the muscle tension. When the temperature lowers, muscle tension is increased. It is also naturally increased by work as well as by various nervous influences. Fear, worry, anxiety, expectancy, so-called "nervousness," are conditions in which muscular tension is greatly increased. Tension may, in fact, by these means be doubled or even more than trebled. This accounts for the fact that a person becomes tired when waiting. It also explains the fatigue and even exhaustion which is felt after an anxious hour, or a period of great mental and nervous excitement, even without any considerable degree of muscular activity.

Cold increases muscular tension to a very marked degree. This accounts for the phenomenon of shivering, which is simply greatly exaggerated muscular tension. Nature increases muscular tension even to the extent of producing tremor or visible muscular movements for the purpose of increasing the heat production necessary to maintain the body temperature. The strong shivering, with chattering of the teeth, which occurs when the body is exposed to great cold, is a remedial effort by which the lowering of the temperature of the blood is prevented. If the muscles are made to contract by electricity or by voluntary exercise, the shivering quickly ceases.

In the management of feeble invalids, it is highly necessary to take great care to prevent the loss of energy through unnecessary nerve tension. The "rest cure" is often necessary in such cases to prevent the waste of energy through tension and thus afford an opportunity for a gain in weight.

Persons between twenty and fifty years of age require, on the average, about three and two-thirds calories per hour per square foot of body surface, or eighty-eight calories per square foot of surface for each twenty-four hours.

Metabolism and Mental Work.

There can be no doubt that mental work requires the expenditure of a certain amount of energy. This is clearly indicated by the amount of blood supplied to the brain, nearly one-fifth the total blood supply of the body; but careful experiments by Benedict and Carpenter and other investigators, have shown that the amount of energy expended during severe brain work is so small that it cannot be accurately measured. This is not surprising, however, when it is considered that the weight of the brain and nerve substance is only about one-fiftieth of the total weight of the body. It seems probable that the chief reason for the large blood supply of the brain is to carry away the fatigue poisons which are produced by brain activity.

The thyroid gland has a marked influence upon metabolic activity. When the gland is excessively active, as in exopthalmic goiter or Graves' disease, the rate of metabolism may be doubled. This fact explains the emaciation and exhaustion which accompany this disorder. On the other hand, when the thyroid gland is under-developed, or inactive, as in myxedema or creatinism, the rate of metabolism may be very greatly diminished.

Metabolism is increased in various conditions of disease, particularly in fever, in lymphatic leukemia, in severe diabetes, in certain cases of heart disease, and sometimes in cancer. In fever and in pernicious anemia, there may be disturbances of metabolism, also in disease of the pituitary and other ductless glands. Some observers have noticed a marked increase of metabolism in acidosis, which may result from either disease or a deficiency of carbohydrates in the diet.

Metabolism is decreased in advanced age, by prolonged fasting and by sleep. It is greatly increased by a diet rich in protein, as after a hearty meal of meat.

Metabolism and Muscular Work.

Muscular exercise is by all odds the most powerful means of increasing metabolism. In an average man whose metabolism is at the rate of about eighty calories per hour when in a state of complete rest, the expenditure will become eighty-four calories per hour when sitting up. Active work will increase the expenditure to three hundred calories per hour, and a higher rate of expenditure may be developed by very vigorous work. That is, by muscular effort, the rate of metabolism may be increased to four or even eight times what it is in a state of complete rest.

Exercise also increases the expenditure through muscular tension during sleep as well as during the waking hours. After vigorous work, for example, the expenditure of energy during sleep after severe work may be increased from ten to twenty-five per cent. above the rate of sleep after rest.

It is evident, then, that in determining the amount of food required in an individual case, it is necessary to take careful note of the number of hours spent in sedentary work and in active exercise.

Energy Expenditure in Work of Various Sorts.

When lying at rest, the energy expenditure is at a minimum, or approximately 12 calories per pound of body weight. For a person weighing 154 pounds (70 kilos), the expenditure would be 1,848 calories for the twenty-four hours. On rising to a sitting position, the output of energy is increased 5 per cent.; standing with the muscles relaxed, produces an increase of 10 per cent. in the energy expenditure; and standing with the muscles rigid, as in the position of "attention," increases the energy output to 14 per cent.

In walking an hour at the rate of three miles an hour, the maximal velocity for economy, the body expends 1.1 calories for each pound transported; that is, for each pound of body weight plus any weight which may be carried. Walking at the rate of 5.3 miles per hour raises the energy output to 3.6 calories per pound of body weight per hour.

To the energy represented by the work done in walking must be added, of course, the basal metabolism or the energy output of rest increased by 10 per cent. for the standing position.

A somewhat different method of calculating the work done in walking, which gives closely similar results, is based upon the observations made by Zuntz, who found that walking 13 feet on a level at the rate of 3 miles an hour requires an energy expenditure about equivalent to that required to lift the body vertically one foot. Consequently, the amount of work done in walking a mile at the rate of 3 miles an hour is found by multiplying the transported by 400 (5,280 ÷ 13 = 406).

The work done by the muscles in transporting the body is about three times that represented in the mechanical work done. The energy value of the work done in walking at a moderate gate may be obtained by multiplying the distance traveled in miles at the rate of three miles an hour first by 400, then by 3, then dividing the product by 3,000, or what would be the same, by 1,000. To determine the actual energy expenditure in the work done, it is necessary to multiply the amount of mechanical work expressed in foot pounds by the factor three for the reason above given.

These figures hold good only when a person is walking on a level road. If a hill is climbed, the work done in lifting the body through the vertical height ascended must be added. This is readily obtained in foot pounds by multiplying the weight transported by the number of feet through which it is lifted.

In walking down an incline of 5 per cent., the energy output in walking has been shown by Zuntz to be about one-half that in walking on a level. Descending an incline of 10 per cent., the energy expenditure is the same as that in walking over a level surface. In going down an incline of 25 per cent., the energy expenditure is doubled. The energy expenditure in bicycle riding is about one-half that required in walking the same distance.

Example. A man weighing 160 pounds with a resting metabolism of 1,800 calories walks for one hour at the rate of 3 miles an hour, carrying a weight of 50 pounds and climbing a hill 1,500 feet in height. The weight of the body, plus the weight carried, equals 210 pounds. This multiplied by 1.1 equals 231, the number of calories required for transporting the weight on a level. The base metabolism during the hour spent in climbing would be 82 calories. Lifting a weight of 210 pounds to a height of 1500 feet will require an expenditure of 315 calories (210 multiplied by 1,500 divided by 1,000 equals 315). The total expenditure will be 628 calories (231 plus 82 plus 315 equals 628 calories for the hour); certainly a large output, but not more than frequently occurs in such violent exertion as mountain climbing.

Carrying the example further, let us suppose that the individual who has spent an hour in executing the task above described rests for the rest of the 24 hours, 8 hours in bed and 15 hours sitting. The basal metabolism during the 8 hours in bed would be 75 calories per hour or a total of 600 calories. In sitting, the energy output would be approximately 80 calorics per hour. In 15 hours this would amount to 1,230 calories, making a total of 2,428 calories, which would represent the energy output and the food intake required to supply the energy expended for the twenty-four hours.

Energy Output and Food Requirement of Persons Engaged in Different Occupations.

The energy expenditure required by different occupations varies very greatly. Careful observations made by various investigators have shown the actual energy requirement of different occupations for a person weighing 154 pounds to be about as follows:

Occupation	Calories of Metabolism Per Day
Bookbinder	2,440
Shoemaker	2,510
Carpenter	3,100
Metal worker	2,900
Painter	2,950
Stonemason	4,200
Man sawing wood	4,800

The Energy Expended in Housework.

Benedict and Johns have made (1919) a valuable series of observations for the purpose of determining the energy expenditure required by ordinary light household activities. The observation was made by a study of the energy output of fifteen or twenty young women before and after entering a large airtight chamber in which they were engaged in performing some household operation, all doing exactly the same thing in the same way.

The conclusions reached may be briefly stated as follows:

1. When sitting quietly in the experimental chamber, two hours after a meal, the energy expenditure was one-half calory per pound of body weight per hour.

2. Reading aloud increased the energy expenditure three per cent.

3. The energy expenditure when singing was increased twenty-two per cent.

4. The exercise of plain sewing occasioned a smaller expenditure of energy than singing, being less than two-thirds as much, or thirteen per cent.

5. The energy expenditure in standing was nine per cent. greater than in sitting.

6. Sweeping caused an increase of one hundred and fifty per cent.

7. Moderate walking increased the energy loss two hundred and fifty per cent.

8. Dusting increased the loss by one hundred and thirty-four per cent.

9. The energy loss occasioned by the act of rising up and sitting down once a minute during three minutes, showed an increased energy loss of sixty per cent. of the energy lost in the sitting posture.

The Relation of Work to Total Food Requirement.

The amount of external mechanical work done by the body represents but a very small part of the total energy expenditure. It is to be remembered that in the case of the body, as in that of the steam engine, much more energy is lost in heat as a by-product than is utilized in mechanical work, besides the large amount of energy required for carrying on the various vital processes of the body. In general, it is held by physiologists that the energy of the food intake should be 5 or 6 times that represented by the external work done.

In increasing the intake of food to support an increase of work beyond the rest ration requirement it is not necessary to increase the protein, and the fats need be increased but very little. The chief increase should be in carbohydrates, for carbohydrates furnish the sugar which constitutes the fuel of the muscles.

The Rate of Growth.

The food intake is closely related to age and rate of growth. The younger the animal the more rapidly it grows. The body of an infant increases in weight 7 times as fast between the ages of one month to three months as between the sixth and ninth month, the average increase being, for the first 3 months, about 3.6 pounds; for the second 3 months, 3.6 pounds; from 6 to 9 months, 3.4 pounds; and from 9 to 12 months, 3 pounds; an average of one and one-tenth pounds per month, or about two-thirds of an ounce a day. During the first month the rate of increase is more than an ounce daily.

The crying of a baby may double its metabolism rate. On this account babies that cry much do not gain in weight. However, a certain amount of crying is good exercise for an infant and promotes good digestion and healthy growth.

The growth of the body is notably more rapid during the first 5 years of life than later. The weight of a healthy infant is three times as great at the end of the first year as at its birth. The weight doubles during the second year.

During the second period of five years, that is, 5 to 10 years, boys grow more rapidly than girls, and at 10 years of age average two or three pounds more in weight. Between the ages of 10 and 15 years, girls grow more rapidly than boys. For the two years, 12½ to 14½, girls are taller than boys of the same age, and from 12½ to 15½ years, exceed boys of the same age in weight by three or four pounds. After 15, boys grow more rapidly than girls, increasing in weight at the rate of nearly seven pounds a year, while girls increase only two and three-quarters pounds yearly. Girls reach their full height and weight at 20 years, while boys continue to grow until 23 and increase considerably in breadth and weight after this age. Girls remain nearly stationary between the ages of 20 and 30 years.

After the age of 35 years, adults increase in weight at the rate of about three-quarters of a pound annually. It is a curious fact that while below the height of 67 inches men are usually heavier than women of the same age, above this height women are heavier than men of the same height and age.

The accompanying tables, copied from an admirable paper by Emerson and Manny of the Boston "Nutrition Clinic" embody the results obtained by Bowditch, Peckham, Boas, Burk, Holt, Greenwood and others in the measurement of more than 400,000 children and afford the best information available respecting the normal rate of growth and development.

TABLE III.

Showing Annual Increase in Weight of Boys and Girls.

BOYS

Age	Year—52 Weeks Pounds	Year—52 Weeks Ounces	Quarter—13 Weeks Pounds	Quarter—13 Weeks Ounces	Week Pounds	Week Ounces
Birth to 1 year	13.45	215.2	3.3625	53.8	.259	4.14
1 to 2 years	6.3	100.8	1.575	25.2	.121	1.94
2 to 3 years	5.2	83.2	1.3	20.8	.100	1.60
3 to 4 years	4.3	68.8	1.075	17.2	.083	1.32
4 to 5 years	4.0	64.0	1.0	16.0	.077	1.23
5 to 6 years	4.0	64.0	1.0	16.0	.077	1.23
6 to 7 years	4.3	68.8	1.075	17.2	.083	1.32
7 to 8 years	5.0	80.0	1.25	20.0	.096	1.54
8 to 9 years	5.1	81.6	1.275	20.4	.098	1.57
9 to 10 years	5.8	92.8	1.45	23.2	.112	1.79
10 to 11 years	5.3	84.8	1.325	21.2	.102	1.63
11 to 12 years	6.2	99.2	1.55	24.8	.119	1.91
12 to 13 years	7.9	126.4	1.975	31.6	.152	2.43
13 to 14 years	10.4	166.4	2.6	41.6	.200	3.20
14 to 15 years	12.2	195.2	3.05	48.8	.235	3.75
15 to 16 years	13.6	217.6	3.40	54.4	.262	4.18

GIRLS

Age	Year—52 Weeks Pounds	Year—52 Weeks Ounces	Quarter—13 Weeks Pounds	Quarter—13 Weeks Ounces	Week Pounds	Week Ounces
Birth to 1 year	13.34	213.44	3.335	53.36	.257	4.11
1 to 2 years	6.0	96.0	1.50	24.0	.115	1.85
2 to 3 years	5.0	80.0	1.25	20.0	.096	1.54
3 to 4 years	3.8	60.8	.95	15.2	.073	1.17
4 to 5 years	3.6	57.6	.9	14.4	.060	1.11
5 to 6 years	3.6	57.6	.9	14.4	.069	1.11
6 to 7 years	4.3	68.8	1.075	17.2	.083	1.32
7 to 8 years	4.8	76.8	1.2	19.2	.092	1.47
8 to 9 years	4.9	78.4	1.225	19.6	.094	1.51
9 to 10 years	5.5	88.0	1.375	22.0	.106	1.69
10 to 11 years	6.6	105.6	1.65	26.4	.127	2.03
11 to 12 years	9.2	147.2	2.3	36.8	.177	2.83
12 to 13 years	10.0	160.0	2.5	40.0	.192	3.08
13 to 14 years	9.6	153.6	2.4	38.4	.185	2.95
14 to 15 years	8.4	134.4	2.1	33.6	.175	2.59
15 to 16 years	5.6	89.6	1.4	22.4	.108	1.72

The effects of the earlier occurrence of puberty in girls than in boys is clearly shown in the above table. Between the ages of 10-13 years inclusive, girls increase in weight an average of 25.8 pounds, while boys increase only 19.4 pounds in weight; but in the years 13—16, boys increase in weight by 36.2 pounds, while girls make a gain during these years of only 23.6 pounds.

TABLE IV.

Showing Normal Rate of Development in Boys.

BOYS

Age Years	Age Months	Height in Inches	Weight in Pounds	Age Years	Age Months	Height in Inches	Weight in Pounds
Birth	0	*20.6	* 7.55	9	0	50.0	59.6
	2	*22.5	*10.4	9	2	50.3	60.6
	4	*24.5	*13.2	9	4	50.6	61.5
	6	*26.5	*16.0	9	6	51.0	62.5
	8	*27.5	*17.7	9	8	51.3	63.5
	10	*28.5	*19.3	9	10	51.6	64.4
1	0	*29.5	*21.0	10	0	51.9	65.4
1	2	*30.3	*22.1	10	2	52.2	66.3
1	4	*31.1	*23.3	10	4	52.5	67.2
1	6	*32.0	*24.5	10	6	52.7	68.0
1	8	*32.7	*25.5	10	8	53.0	68.9
1	10	*33.4	*26.4	10	10	53.3	69.8
2	0	*34.0	*27.3	11	0	53.6	70.7
2	2	*34.7	*28.2	11	2	53.9	71.7
2	4	*35.4	*29.1	11	4	54.2	72.7
2	6	*36.0	*30.0	11	6	54.5	73.8
2	8	*36.5	*30.8	11	8	54.8	74.8
2	10	*37.0	*31.6	11	10	55.1	75.9
3	0	*37.5	*32.5	12	0	55.4	76.9
3	2	*38.0	*33.2	12	2	55.8	78.2
3	4	*38.5	*34.0	12	4	56.1	79.5
3	6	*39.0	*34.7	12	6	56.5	80.8
3	8	*39.5	*35.4	12	8	56.8	82.1
3	10	*40.0	*36.1	12	10	57.2	83.5
4	0	*40.5	*36.8	13	0	57.5	84.8
4	0	39.5	37.2	13	2	57.9	86.5
4	2	39.9	37.9	13	4	58.3	88.3
4	4	40.2	38.5	13	6	58.7	90.0
4	6	40.6	39.2	13	8	59.2	91.8
4	8	41.0	39.8	13	10	59.6	93.5
4	10	41.4	40.5	14	0	60.0	95.2
5	0	41.7	41.2	14	2	60.5	97.2
5	2	42.1	41.8	14	4	61.0	99.3
5	4	42.4	42.4	14	6	61.5	101.3
5	6	42.8	43.1	14	8	61.9	103.3
5	8	43.2	43.8	14	10	62.4	105.3
5	10	43.5	44.5	15	0	62.9	107.4
6	0	43.9	45.2	15	2	63.2	109.7
6	2	44.3	45.9	15	4	63.6	111.9
6	4	44.7	46.6	15	6	63.9	114.2
6	6	45.1	47.3	15	8	64.2	116.5
6	8	45.4	48.1	15	10	64.6	118.8
6	10	45.7	48.8	16	0	64.9	121.0
7	0	46.0	49.5	16	2	65.1	122.5
7	2	46.5	50.3	16	4	65.5	124.0
7	4	46.9	51.2	16	6	65.7	125.5
7	6	47.4	52.0	16	8	65.9	127.0
7	8	47.9	52.8	16	10	66.1	128.5
7	10	48.3	53.6	17	0	66.5	130.0
8	0	48.8	54.5	17	2	66.7	130.9
8	2	49.0	55.4	17	4	66.8	131.7
8	4	49.2	56.2	17	6	67.0	132.6
8	6	49.4	57.1	17	8	67.2	133.4
8	8	49.6	57.9	17	10	67.3	134.3
8	10	49.8	58.8	18	0	67.4	135.1

*Without Clothing.

TABLE V.

Showing Normal Rate of Development in Girls.

GIRLS

Age		Height in Inches	Weight in Pounds
Years	Months		
Birth	0	*20.5	* 7.16
	2	*22.3	* 9.9
	4	*24.2	*12.7
	6	*26.0	*15.5
	8	*27.0	*17.2
	10	*28.0	*18.8
1	0	*29.0	*20.5
1	2	*29.8	*21.7
1	4	*30.6	*22.8
1	6	*31.4	*24.0
1	8	*32.0	*24.8
1	10	*32.7	*25.6
2	0	*33.4	*26.5
2	2	*34.0	*27.3
2	4	*34.6	*28.1
2	6	*35.3	*29.0
2	8	*35.9	*29.8
2	10	*36.5	*30.6
3	0	*37.0	*31.5
3	2	*37.5	*32.1
3	4	*38.0	*32.7
3	6	*38.5	*33.3
3	8	*39.0	*34.0
3	10	*39.5	*34.6
4	0	*40.0	*35.3
4	0	39.7	36.2
4	2	39.7	36.8
4	4	40.0	37.4
4	6	40.4	38.0
4	8	40.7	38.6
4	10	41.0	39.2
5	0	41.3	39.8
5	2	41.6	40.4
5	4	41.9	41.0
5	6	42.3	41.6
5	8	42.6	42.2
5	10	42.9	42.8
6	0	43.3	43.4
6	2	43.7	44.1
6	4	44.1	44.8
6	6	44.5	45.5
6	8	44.9	46.2
6	10	45.3	46.9
7	0	45.7	47.7
7	2	46.0	48.5
7	4	46.4	49.3
7	6	46.7	50.1
7	8	47.0	50.9
7	10	47.4	51.7
8	0	47.7	52.5
8	2	48.0	53.3
8	4	48.4	54.1
8	6	48.7	55.0
8	8	49.0	55.8
8	10	49.4	56.6
9	0	49.7	57.4
9	2	50.0	58.3
9	4	50.4	59.2
9	6	50.7	60.2
9	8	51.0	61.1
9	10	51.4	62.0
10	0	51.7	62.9
10	2	52.1	64.0
10	4	52.4	65.1
10	6	52.8	66.2
10	8	53.2	67.3
10	10	53.5	68.4
11	0	53.8	69.5
11	2	54.1	71.0
11	4	54.5	72.6
11	6	54.9	74.1
11	8	55.3	*75.7
11	10	55.7	77.2
12	0	56.1	78.7
12	2	56.5	80.4
12	4	56.9	82.0
12	6	57.3	83.7
12	8	57.7	85.4
12	10	58.1	87.0
13	0	58.5	88.7
13	2	58.9	90.3
13	4	59.2	91.9
13	6	59.5	93.5
13	8	59.8	95.1
13	10	60.1	96.7
14	0	60.4	98.3
14	2	60.6	99.7
14	4	60.8	101.1
14	6	61.0	102.5
14	8	61.2	103.9
14	10	61.4	105.3
15	0	61.6	106.7
15	2	61.7	107.6
15	4	61.8	108.6
15	6	61.9	109.5
15	8	62.0	110.4
15	10	62.1	111.3
16	0	62.2	112.3
16	2	62.3	112.8
16	4	62.4	113.3
16	6	62.5	113.8
16	8	62.5	114.4
16	10	62.6	114.9
17	0	62.7	115.4

Without clothing.

TABLE VI.

Showing Normal and Deficient Weight for Different Heights in Boys and Girls.

	BOYS			GIRLS			
Height Inches	*Average Weight for Height Pounds*	*7% Under-weight Pounds*	*10% Under-weight Pounds*	*Average Weight for Height Pounds*	*7% Under-weight Pounds*	*10% Under-weight Pounds*	*Height Inches*
*21	8.2	7.6	7.4	7.9	7.3	7.1	21*
*22	9.7	9.0	8.7	9.4	8.7	8.5	22*
*23	11.1	10.3	10.0	11.0	10.2	9.9	23*
*24	12.5	11.6	11.3	12.5	11.6	11.3	24*
*25	13.9	12.9	12.5	14.0	13.0	12.6	25*
*26	15.3	14.2	18.8	15.5	14.4	14.0	26*
*27	16.9	15.7	15.2	17.2	16.0	15.5	27*
*28	18.5	16.2	16.7	18.8	17.5	16.9	28*
*29	20.2	18.8	18.2	20.5	19.1	18.5	29*
*30	21.7	20.2	19.6	22.0	20.5	19.8	30*
*31	23.2	21.6	20.9	23.4	21.8	21.1	31*
*32	24.5	22.8	22.1	24.8	23.1	22.3	32*
*33	25.9	24.1	23.3	26.0	24.2	23.4	33*
*34	27.3	25.4	24.6	27.3	25.4	24.6	34*
*35	28.7	26.7	25.8	28.6	26.6	25.7	35*
*36	30.0	27.9	27.0	30.0	27.9	27.0	36*
*37	31.6	29.4	28.4	31.5	29.3	28.4	37*
*38	33.2	30.9	29.9	32.7	30.4	29.4	38*
39	36.3	33.8	32.7	35.7	33.2	32.1	39
40	38.1	35.4	34.3	37.4	34.8	33.7	40
41	39.8	37.0	35.8	39.2	36.5	35.3	41
42	41.7	38.8	37.5	41.2	38.3	37.1	42
43	43.5	40.5	39.2	43.1	40.1	38.8	43
44	45.4	42.2	40.9	44.8	41.7	40.3	44
45	47.1	43.8	42.4	46.3	43.1	41.7	45
46	49.5	46.0	44.6	48.5	45.1	43.7	46
47	51.4	47.8	46.3	50.9	47.3	45.8	47
48	53.0	49.3	47.7	53.3	49.6	48.0	48
49	55.4	51.5	49.9	55.8	51.9	50.2	49
50	59.6	55.4	53.6	58.3	54.2	52.5	50
51	62.5	58.1	56.3	61.1	56.8	55.0	51
52	65.8	61.1	59.2	63.8	59.3	57.4	52
53	68.9	64.1	62.0	66.8	62.1	60.1	53
54	72.0	67.0	64.8	70.3	65.4	63.3	54
55	75.4	70.1	67.9	74.5	69.3	67.1	55
56	79.2	73.7	71.3	78.4	72.9	70.6	56
57	82.8	77.0	74.5	82.5	76.7	74.3	57
58	87.0	80.9	78.3	86.6	80.5	77.9	58
59	91.1	84.7	82.0	91.1	84.7	82.0	59
60	95.2	88.5	85.7	96.7	89.9	87.0	60
61	99.3	92.3	89.4	102.5	95.3	92.2	61
62	103.8	96.5	93.4	110.4	102.7	99.4	62
63	108.0	100.4	97.2	118.0	109.7	106.2	63
64	114.7	106.7	103.2	123.0	114.4	110.7	64
65	121.8	113.3	109.6	130.0	120.9	117.0	65
66	127.8	118.9	115.0	137.0	127.4	123.3	66
67	132.6	123.3	119.3	143.9	133.0	128.7	67
68	138.9	129.2	125.0	146.9	136.6	132.2	68

*Without Clothing.

Food Requirements by Men, Women and Children.

The following table, based largely upon the work of Atwater and Benedict, shows the amount of food required by beings of different sex and ages, taking the ration of an adult man as the unit:—

Man	1.0
Woman	.8
Boys (14-17)	.8
Girls (14-17)	.7
Children (10-13)	.6
Children (6-9)	.5
Children (2-4)	.4
Children (under 2)	.3

Changes Which Take Place in the Body in Old Age.

The general tendency throughout the body in advancing age is for the development of cells of a comparatively low type, such as the connective tissue cells. These cells, tending to increase in the liver, kidneys and various other organs, crowd out and destroy the higher cells and hence produce impairment of function in important excretory and other organs. The same changes take place in the brain and nerves and are especially active in the arteries, causing arteriosclerosis. Certain of the white blood corpuscles also take part in this degenerative process, as shown in the whitening of the hair, which is due to the robbing of the hair of pigments by white blood cells (macrophags), and destruction of the supporting structures of the bones, causing porosity and weakening of these structures.

The Quantity of Food Required in Old Age.

The food should be steadily reduced in quantity with advancing age. No doubt many elderly persons eat more than is wholesome for them. As weight and bodily activity diminish, the food intake should be proportionately diminished. According to Maurel and Quatelet, the food requirement of persons in advanced years is as shown in the following table:

Age	MEN		WOMEN	
Years	Weight, Lbs.	Calories	Weight, Lbs.	Calories
60	144	1963	125	1700
70	139	1890	118	1600
80	135	1530	113	1300
90	117	1450	108	1230

Physique and Diet.

Zimmer has shown that vigorous muscles, even when at rest, destroy more sugar than do feeble ones, a fact which is easily understood when we remember that the muscles are the furnace of the body, and are the chief seat of the vital combustion by which glycogen, or sugar, is consumed. Large and vascular muscles will naturally consume more sugar than feeble and anemic muscles, just as a large furnace with a good draft will consume more fuel than a small furnace with a poor draft. Under the influence of either massage or exercise, the blood is made to go through the muscles; while in a state of rest it goes around rather than through them.

It thus appears that a robust, well developed person with a good muscle tone needs more food than a weak person whose muscles are soft and relaxed. This fact is usually indicated by a keen appetite in the case of the robust person and its absence in the case of the weak one.

Diet and Metabolism.

The taking of food increases metabolism. Fasting reduces metabolism about ten per cent. Food stimulates the activity of the body cells. In the case of fats and carbohydrates, the stimulating effect is small,—6% for carbohydrates and 14.5% for fats; but in the case of protein, the effect is great, amounting to 40% (Rubner). This is a fact of great importance and should never be lost sight of in the arrangement of bills of fare. Meat has long been regarded as a stimulating or "heating" food, and on that account has been condemned in fevers and as a hot weather diet by most authorities; but it is important to remember that there are numerous conditions of diseases in which marked increase of metabolism is present and in which it is most desirable to suppress influences likely to produce a further increase of metabolic activity.

It is worth while to note, also, that in conditions of disease, when the normal balance of metabolic activities is already upset, further disturbance in the same direction may be easily produced, so that a protein ration which might be tolerated in health, may become highly injurious.

In toxic goiter (Graves' disease), lymphatic leukemia, severe diabetes, certain cases of cancer, fever, and advanced cases of heart disease, there may be a marked increase of metabolism. It is now known, in fact, that hyperthyroidism, with consequent exaggerated metabolism, occurs much more frequently than was formerly supposed. In all these conditions, which include a very large number of clinical cases, comprising all febrile cases, it is very evident that a very low protein diet is indicated. This naturally requires the exclusion of meat and meat extracts and broths of all sorts from the diet, in such cases. Every experienced physician can recall cases in which the temperature of a fever patient has risen sharply after the taking of meat. For many years, the writer has excluded meats and meat products of all sorts from the surgical wards under his supervision and with marked benefit in the avoidance of postoperative fever as well as acidosis and other complications.

Diet and Development.

The remarkable influence of food upon bodily growth and development is not only a matter of common observation but is most forcibly illustrated by the results of laboratory experiments and certain remarkable natural history facts. Gudernatsch, in experiments upon tadpoles, found that if fed on thymus gland they grew to be very large but never changed to frogs; whereas, if they were fed on thyroid gland they quickly changed to frogs but remained extremely small, scarcely larger than flies. The larvae of bees fed on "bee bread" become ordinary workers or infertile females; but if fed "royal jelly," they become queens or fertile females. Canary birds fed on sweet red peppers become red in color.

The Standard Ration of Voit.

Voit was the first to establish a standard ration. He required for a man weighing 154 pounds approximately 4 ounces of protein, 2 ounces of fat, and 18 ounces of carbohydrates; more exactly, in calories, protein, 484; fat, 521; carbohydrates, 2050; total, 3055. The research suggested by Horace Fletcher and conducted by Chittenden and Mendel demonstrated that the protein might be reduced to one-third of Voit's standard with an actual gain in health and vigor. Drs. Murlin and Miller of the U. S. Army, after a nutritional survey of the U. S. Army camps, pointed out in their report that "it is the general concensus of opinion among experts in nutrition that an excess of protein is undesirable in the dietary of a hard working man *since muscular work does not involve destruction of muscular tissue beyond the amount sustained in muscular rest.*"

The Physiology of Eating

Physiologic feeding is as necessary for a man as for a race horse or for a competitor for a prize in a poultry show. The average man knows how to feed his horse so as to keep him in the best possible condition for service, but in feeding himself gives no thought to physiologic requirements but swallows whatever his fancy craves or his wife or hired cook sets before him. The farmer's wife knows how to feed cows or chickens so as to secure the largest returns in milk or eggs, but in feeding herself and her family gives little thought to physiologic needs. Unphysiologic eating is the active or predisposing cause of many chronic maladies. Biologic habits of eating should be formed in childhood and carefully adhered to during adult life. The so-called pleasures of the table are usually illicit enjoyments resulting from the indulgence of artificial tastes and depraved appetites from which a brief temporary felicity is derived at the expense of subsequent long drawn out misery and disease.

Physiologic or biologic feeding requires careful adjustment of the food supply in quality and quantity to the nutritive needs of the body. A hundred years ago, even twenty years ago, it was difficult to do this. Many of the most important questions pertaining to nutrition were then only vaguely answerable. The clearly defined straight road in human feeding had not yet been scientifically marked out, but today this is no longer true. Careful laboratory experiment and scientific observation and research have solved so many of the problems and settled so many mooted questions it is now possible to feed human beings in as thoroughly a scientific manner as horses, cows, pigs and chickens are fed, and the results in human beings are equally as striking as those in domestic animals.

The Protein Ration

Protein is that element of the food which is used for the construction and repair of the highly vitalized or living tissues of the body; that is, the vital machinery, consisting of muscles, glands, nerves and other parts concerned in the various activities or functions of the body, consist of protein. Between the periods of infancy and maturity, protein is required both for growth and repair. Recent experiments made in animal feeding indicate that in growing animals more than one-half (55 per cent.) of the protein intake is utilized in the formation of new tissue. After maturity, the sole use of protein is for repair. The practical question, then, in the adult individual is, How much protein is required to make good the daily wear and tear of the body, or the necessary loss from the breaking down of the living structures as the result of work?

This question is one of very great practical interest, for Folin and other physiologists have shown that all surplus protein above what is required for repair is not only useless, not being necessary to satisfy any bodily need, but is a positive damage to the body, because it imposes upon the eliminative organs, especially the liver and kidneys, a heavy burden of unnecessary work, the inevitable effect of which must be to wear out these organs prematurely and to interfere with their normal functions of destroying and eliminating the natural body wastes and thus keeping the blood and tissue fluids free from obstructing poisons.

Probably the majority of persons who have given some thought to the question of the protein ration are laboring under the supposition that this question is a very new one, and that it is still a matter of experiment whether or not human life and vigor may be well maintained on a dietary which furnishes not more than one-third or one-half the amount of protein generally consumed. This is, however, quite an error. More than twenty years ago, when the question of the deficiency of protein in the Japanese dietary was raised by Mori, a special investigation was undertaken by a Japanese physiologist, Kumagawa, for the purpose of settling this question. He found that with his ordinary diet of Japanese foods only 54 grams of protein were eaten, less than half the amount required by Voit, and still smaller than Atwater's standard. He also found that this diet furnished the body more protein than it actually required and reached the conclusion that a larger amount of protein than this is quite unnecessary, and that only a very small amount of protein is really needed, the important point being that the body shall be furnished with a sufficient amount of fat and carbohydrates to maintain the supply of energy required by the tissues. He found also that an increase in the protein intake did not increase the amount of protein in the body but only increased the amount of urea found in the excretions.

Numerous physiologists have contributed experimental observations toward the settlement of the question, What should be the daily intake of protein?

Klemperer, experimenting upon two young men who weighed respectively 141 and 144 pounds, found the protein consumption to be in one, 27.4 grams, a trifle less than one ounce, and in the other 22.4 grams or three-fourths of an ounce.

Siven, in experiments upon himself, found 28 grams, or one ounce of protein, sufficient to meet his bodily needs.

Many years ago, 1887, Hirschfeld had demonstrated the sufficiency of 37.5 grams (one and one-fourth ounces) of protein to supply the needs of the body; and this notwithstanding the fact that his ordinary diet previous to the experiment had contained 130 grams, or more than three times the necessary amount.

Voit, the eminent German physiologist, had previously established a dietetic standard of 118 grams of protein (more than four ounces) as the necessary requirement, and Atwater had considerably raised this standard as the result of observations upon some 15,000 people in whom he found the consumption of protein to vary from 100 to 175 grams (three and one-half to six ounces). The great difference in the conclusions reached by these different investigators rendered necessary a critical examination of the question. A thoroughgoing and decisive experimental research was finally undertaken, the conclusions of which have not only remained to the present time unshaken but have been so abundantly reinforced by the findings of other investigators that they may now be said to be established for all time. The genesis of this investigation, known as the Chittenden research, is of such unusual interest that it will be worth while to devote a little space to its presentation, especially as the facts have never before been made public.

A few years previous to the year 1902, Mr. Horace Fletcher, an American, at that time living in Venice, in an effort to improve his health so as to enable him to pass a life insurance examination, had been led to the discovery of the value of thorough mastication of the food as an aid to digestion and nutrition. Of course, the value of thorough chewing of the food had been known before, having been especially pointed out by Spallanzani in 1780, also by Dr. Beaumont and by Brillat-Savarin. It was known that Gladstone required his children to chew each morsel of meat forty times before swallowing it, and the writer had for 25 years consistently advocated thorough mastication as a necessary prelude to good digestion, with both voice and pen.

Mr. Horace Fletcher had become a chewing enthusiast and felt that he had discovered in the thorough mastication of the food a real panacea, not only for indigestion but for all maladies of nutrition, and, indeed, his enthusiasm even led him to the belief that thorough mastication of the food, if it could be made to become universal, would result in the physical, mental and moral regeneration and redemption of the race.

Soon after beginning the practice of thorough chewing, Mr. Fletcher made the discovery that less food was required to satisfy the sense of hunger and to supply all essential bodily needs. He found that while the lessened intake of food reduced his weight, both his bodily strength and his endurance were to a marked degree increased. He also observed that the appetite for meat and other food rich in protein steadily diminished until the amount of his protein intake was but a small fraction of what it had been before. He made these facts known to physiologists, whom for the most part he found very skeptical. He soon saw the necessity for securing an authoritative investigation, the results of which would be accepted by scientific critics.

After appealing to numerous European scientists, Mr. Fletcher came to this country. On my invitation he made a visit to Battle Creek. During the week which he remained as a guest of the Sanitarium, he told me of his experience and unfolded to me his plans. He stated that he had arranged with Professor Chittenden to undertake an elaborate experiment in which he was to employ as subjects a considerable number of soldiers who had been detailed by the War Department for the purpose. He had promised to bear a considerable part of the expense of the experiment, which he afterwards told me he did do to the amount of several thousand dollars. Mr. Fletcher was so confident of the results of the projected experiment that he did not hesitate to predict that the amount of protein found to be necessary for normal nutrition would be so small that the use of meat as an element of the diet would become practically impossible without increasing the amount of protein beyond the normal limit.

The writer naturally watched with much interest for the report of Professor Chittenden's research, and when it appeared in 1904 was gratified to find that Mr. Fletcher's prediction had been more than realized.

In his research, Professor Chittenden employed sixteen soldiers detailed for the purpose, four college professors and instructors and two athletes. The protein intake of these subjects was gradually reduced, and at the end of the experiment, which lasted for nine months, the average consumption was found to be less than one-third the amount customarily eaten at the beginning of the experiment. In the case of Professor Chittenden himself, whose weight remained stationary at 125.4 pounds after dropping from 143 pounds, the daily intake of protein was at the close of the experiment less than 34 grams (one and one-sixth ounce). Two years later Professor Chittenden informed the writer that his daily intake of protein was only 31 grams (a little more than one ounce). On this ration his strength and vigor were well maintained and, indeed, he had made considerable improvement in health, having gotten rid of various discomforts which were evidently the result of an excessive protein intake.

Professor Chittenden says, "With these facts before us, it is difficult to accept the assumption that dietetic customs afford any indication of the food requirements of the body. To the physiologist such a view does not appeal, since there is a lack of any scientific evidence that carries conviction."

The Chittenden Standard.

According to Chittenden, one-third gram per pound of body weight of protein, or one and one-third calories per pound of body weight, is quite sufficient to fully meet the requirements of the body. Sherman has recently placed the protein requirement of the body at the still lower level of one calory per pound of body weight. From Folin's experiments this would seem to be ample, since this most reliable investigator has shown that the greater part of the protein taken in the food is excreted by the kidneys in the form of urea without ever having been assimilated or utilized by the tissues. Folin holds that utilized protein is represented in the urine by creatinin, which agrees with the observation of Liebig that in hunted foxes the amount of creatinin found in the muscles is ten times the normal quantity. Tibbles holds that the physiologic minimum of protein is one-half gram per kilogram of body weight, or a little less than one calory per pound of body weight, an observation which agrees with the recent very extensive research of Sherman. The experiments conducted by Siven led to the same conclusion.

For some years after Professor Chittenden announced the results of his notable research, Dr. Benedict and others of the Atwater school, vigorously opposed the low protein standard advocated by Chittenden and his associates, pronouncing it unsafe and questioning its scientific basis.

In defending his position, Professor Chittenden quotes Professor Benedict as saying:

"Food should be ingested in just the proper amount to repair the waste of the body; to furnish it with the energy it needs for work and warmth; to maintain it in vigor; and, in the case of immature animals, to provide the proper excess for normal growth, in order to be of the most advantage to the body."

Professor Chittenden also remarks that, "Voit, among others, has clearly emphasized the general principle that the smallest amount of proteid, with non-nitrogenous food added, that will suffice to keep the body in a state of continual vigor is the ideal diet."

No physiologist will question the accuracy of the statement that the ideal diet is the smallest amount of food which is "sufficient to keep up that strength of body and mind that is essential to good health, to maintain the highest degree of physical and mental activity with the smallest amount of friction and the least expenditure of energy, and to preserve and heighten, if possible, the ordinary resistance of the body to disease germs."

All surplus of food is a wasteful burden to the body and a handicap to its energies. This is true even of fats and carbohydrates, an excess of which is readily disposed of by being deposited beneath the skin in the form of fat, a reserve source of energy which may be drawn upon in time of need; but it is especially true of protein, a substance which cannot be stored in the body, which can be utilized only in the small amount required to replace the losses due to natural wear and tear. This amount, the above considerations clearly show to be approximately one ounce to an ounce and a quarter for the average male adult, or, expressed in units of energy, 110 to 125 calories, the equivalent of about four ounces of lean meat or 6.5 ounces of roast beef.

Another simple, and at the same time most convincing method of determining the necessary protein intake has recently been made known. A few years ago, Rubner made a study of the protein intake of the nursing infant and found it to be one-half gram of protein to the kilogram of body weight, or .9 calories per pound of body weight. Careful investigation has shown that an infant uses fifty per cent of its protein intake for growth, that is, for building up its muscles and glands, blood and other structures. This leaves not more than one-half of one calory per pound of body weight as the amount necessary for tissue repair. It could hardly be claimed that the amount of protein needed for tissue repair per pound of body weight could be greater in an adult than in an infant; hence it is evident that if the intake of protein is fixed at one calory per pound of body weight, much more than Nature provides to the infant to meet its requirement for growth as well as repair, the provision for meeting the demands of the body for repair of its vital machinery will be ample. It is interesting to know that the conclusion reached by this short and direct method is practically identical with the results at which Professor Chittenden arrived through his laborious research. Professor Chittenden weighs 125 pounds. His protein intake is 31 grams or 124 calories, or one calory per pound of body weight.

The subject of one of Professor Rubner's experiments performed in one day work equal to nearly one million foot pounds, of which enormous output of energy it was found that protein supplied only one six-hundredth part. This shows again the fallacy of the popular notion that meat and other highly nitrogenous foods are necessary for the maintenance of strength, especially in persons who are engaged in hard labor.

Other observations by Rubner show that the body may be maintained in health and strength on one-half an ounce of dried protein daily. These facts are of the greatest importance and serve still further to fortify the position of Professor Chittenden in regard to the low protein ration, as well as the practice of non-flesh eaters.

The Japanese have for generations "lived and thrived on a daily ration noticeably low in its content of protein" * * * and "generations of low protein feeding, with the temperance and simplicity in dietary methods thereby implied, have certainly not stood in the way of phenomenal development" (Chittenden).

The experience of the war so overwhelmingly proved the sufficiency of the low protein ration, the opposers of the Chittenden standard were compelled to recognize their error. The report brought back by Professor A. E. Taylor of the general adoption in Germany of the low protein ration and the account given by him of the physical accomplishments of the thousands of workers in the great ammunition factories in Germany, presented facts which could not be ignored, and which led Dr. Benedict of the Carnegie Nutrition Laboratory, of Boston, to plan the "Springfield experiment," which demonstrated in the most conclusive manner the sufficiency of the low protein standard established by the classic research of Chittenden.

Sherman, of Columbia University, published recently the results of a new research of the protein requirement which fully confirms the observations made by Chittenden in his famous research, and gives us new assurance respecting the high value of the proteins found in corn, wheat and oats, the three principal cereal grains.

Sherman proved that nine-tenths of the protein of the diet may be derived from the cereals mentioned, provided that the other one-tenth consists of milk or apple proteins. He also notes that the total protein intake need not exceed .5 grams per kilogram, which is equivalent to a little less than one calory per pound of body weight; that is, a person weighing one hundred and fifty pounds may maintain his total protein requirement upon thirteen ounces of corn meal, nine ounces of graham flour, or seven ounces of oatmeal, provided that in each case the cereal protein is supplemented by the protein found in four ounces of milk. The equivalent of the milk protein will be found in an ounce of cottage cheese.

Professor Sherman's observations agree with the results of large human experience. Corn meal mush and milk was a staple food in the pioneer families of the Middle West half a century ago, and produced the sturdy men and women who have made this great section the very heart of American civic and industrial life. Oatmeal with milk is the staple food of the sturdy Scotch; and buttermilk with oatmeal and potatoes has for generations been the chief nutrients of the hardy Irish peasant.

The protein of the ordinary ration appears to be disposed of in the following ways:

1. A portion is assimilated by the cells lining the intestine and by them converted into blood protein, so that the intestine itself is an important blood-forming organ.

2. A second portion, after conversion into amino-acids or building stones, is carried by the blood to the tissues, where it is utilized for repairing the waste due to wear and tear of the vital machinery.

3. Another portion, probably the greater part of all the protein eaten, never reaches the tissues at all but is converted into urea in the liver and excreted by the kidneys.

Van Slyke has shown that the major part of the food protein is eliminated within 24 hours in the form of urea. This conversion of the excess of protein takes place in the liver and begins within a few minutes after meat is eaten.

On a high protein diet the amount of urea excreted by the kidneys is 33 to 37 grams, or an ounce and a quarter. On a free meat diet the amount may rise to 100 grams, or three and one-third ounces. On a protein-free diet the protein output falls to 9 grams, less than one-third of an ounce, and on a diet based upon the Chittenden standard, the amount excreted is from half an ounce to two-thirds of an ounce. From these facts it is evident that the kidneys of the hearty meat eater are compelled to do from two to five times as much work in the elimination of urea as is required of the kidneys of a low protein feeder. Since Folin has shown that all the urea excreted by the kidneys represents surplus protein, that is, food protein which has never been assimilated and hence has not been utilized for tissue building, it will readily appear that a high protein diet is one of the most efficient methods by which the kidneys may be prematurely worn out and life thus abbreviated.

The protein of the food contains a certain proportion of sulphur. This is separated in the process of digestion and combines with hydrogen, forming hydrogen sulphide, a highly poisonous gas which causes cyanosis when present in sufficient quantity.

This fact is of itself sufficient reason for avoidance of an excess of protein. A pronounced odor of sulphureted hydrogen, usually accompanied by a black or dark brown coloration of the feces, is evidence that protein is being eaten in excess.

Luxus Consumption of Protein.

Tibbles, the eminent English authority on dietetics, in discussing the question of the protein ration, remarks without comment, "Kellogg subscribes to the doctrine that no protein is stored in the system, and considers that all protein above 60 or 70 grammes daily is broken down in the alimentary canal by bacteria into toxins such as indol, skatol, phenol, leucin, tyrosin, etc., and cause autointoxication."

The professor is certainly right in this statement. The writer not only subscribes to the doctrine that no considerable amount of protein is stored in the body, but feels doubly assured, since the work of Folin, that this doctrine rests upon a sound scientific basis. The doctrine of "luxus" protein feeding is justly repudiated by Taylor and other modern physiologists. There is not a particle of evidence that protein is needed in the body for any other purpose than the repair of tissues. Any surplus is treated as waste material and is a burden to the organs of elimination, especially the liver and the kidneys.

It cannot be doubted, of course, that reduction of the protein below the actual needs of the body causes a depreciation of vital resistance, through disturbance of the nutritive balance. The same is true with reference to any other food principle; but the question under discussion is not the effect of an actual deficiency of protein, but the effect of an excess.

Effects of Protein Intake Upon the Urine.

A few years ago (1908) the writer had made in the laboratory of the Battle Creek Sanitarium a careful study of the urine in 24 men and 22 women, all young healthy subjects living upon a moderately low protein diet (Chittenden standard). The accompanying table shows the marked contrast between the urines of persons living on such a diet and on the ordinary mixed diet. An examination of this table shows that the mixed diet requires the kidneys to do an enormous amount of excess and unnecessary work in the elimination of waste products derived from the food directly and not resulting from necessary or productive vital work.

TABLE VII.

		Ordinary or High Protein Diet (Folin)	Low Protein Diet without Meat	Excess
		gms.	gms.	per cent.
Quantity	c. c.	1.430	1.000	43
Total nitrogen	"	16.00	6.440	148
Urea	"	29.80	11.650	155
Uric acid	"	.370	.323	14
Ammonia, in terms of NH_3.	"	.850	.247	244
Chloride	"	10.050	6.455	56
Creatinin	"	1.550	.815	90
Phosphates	"	3.870	1.455	166
Total sulphates	"	3.140	1.071	192
Indican	"	77.000	5.600	1275

A study of the table will show at once the enormous amount of extra work imposed upon the kidneys by a high protein diet. It is to be noticed, for example, that the total quantity of urine eliminated by persons taking an ordinary mixed or high protein diet is forty-three per cent. greater than the amount required by the low protein diet. The acidity is more than double. The total nitrogen, representing the total amount of nitrogenous wastes eliminated, is increased nearly 150 per cent. The urea is increased an equal amount. The ammonia, which is the result of putrefaction in the colon, is increased to nearly three and a half times the normal. Creatinin, which is in large part derived from the meat eaten, is practically doubled. All the products resulting from putrefaction are increased to two or three times that of the low protein urine, and the indican, the direct product of the putrefaction of protein in the colon, is increased nearly thirteen hundred per cent.

These facts show beyond any room for doubt that a high protein diet, or even the ordinary mixed diet which, by including meat, comprises an excess of protein, compels the kidneys to do an enormous amount of extra and harmful work in order to remove from the blood the excessive amount of poisonous wastes thrown into it. The total work done is considerably more than double the total work normally required of the kidneys. Is it not a fair conclusion that kidneys required to do double duty cannot be expected to retain their integrity as long as those required to do only the normal and necessary amount of work?

The great prevalence of degeneration of the kidneys among flesh-eating people and flesh-eating animals, are facts which bear eloquent testimony upon this point.

The liver and the kidneys co-operate in protecting the body against the destructive influence of the waste and poisonous substances derived respectively from the activities of the body cells and the unutilized protein of the food. It has been clearly shown by extended clinical observation that over-loading these essential vital organs with work by eating an excess of protein is one of the most potent causes of disease. The experiments of Chittenden, by which this was clearly demonstrated, have been fully and repeatedly confirmed by more recent investigations.

It is evident, then, that a diet which is sufficient to maintain the body in a state of health and to fully support its activities while at the same time taxing the liver and the kidneys to a minimum extent, must be in the highest degree suited to promotion of endurance and longevity.

A research conducted by Campbell at Singapore and reported in the *Biochemical Journal* (1919), clearly demonstrates the advantage of a low protein diet. The work included the study of the urine in a Brahmin, a Chinese, a Tamil, a Malay, a Hindoo, a Eurasian, a Bengali, a Sikh, and a European. The Brahmin and the Hindoo were vegetarians; the others lived on a mixed diet. It was found that the Brahmin and the Hindoo eliminated much smaller quantities of urea and other waste substances than any of the other subjects and very much less (scarcely half) than the average European (.11 grams N per kilogram for the Brahmin and .127 for the Hindoo).

Modern researches confirm the conception of Liebig that protein is essentially a tissue-building substance, and not primarily intended for body fuel. A dog fed upon lean meat free from fat requires a ration having a much higher caloric value than when fed upon a diet consisting largely of fats and carbohydrates, thus showing that as a source of energy, protein is much inferior to fats and carbohydrates. The relation of the two classes of food principles appears to be essentially the same as that of metal repairs and coal to the locomotive.

A High Protein Diet Increases Intestinal Putrefaction

The careful study of the bacterial flora of the intestine which has been made within recent years by Escherich, Tissier, Metchnikoff, Herter, Levin, Roger, Adami, Cohendy, Gilbert, Dominici, Strassberger, and others has shown the immense influence exerted upon the functions and tissues of the body by bacterial toxins formed within the alimentary canal. Absorbed into the portal blood these poisons are circulated through the liver, where they are in part oxidized and rendered innocuous, and find their way out through the lungs, skin, and especially the kidneys. These investigators and others have shown that there is a close relation between the protein ration and intestinal putrefactions.

Pasteur supposed that bacteria are a necessary aid to intestinal digestion and essential to both animal and plant life. His pupil, Roux, showed that beans may grow in a sterile soil. Nuttal and Thierfelder kept guinea-pigs alive in a sterile medium. Levin examined 480 animals at Spitzbergen,—bears, seals, reindeer, and other animals,—53 species, and established the fact that in the Arctic regions the intestines of mammals are usually sterile.

It seems to be finally settled that bacteria are not necessary for the maintenance of animal life, and certainly that putrefactive bacteria are not only unnecessary, but harmful. Nevertheless, these bacteria are present in the intestines in enormous quantities. Gilbert calculates the number of bacteria daily discharged from the body at 12 trillions. Strassberger makes the number 120 trillions. Roger enumerates 240 species of bacteria which have been found in the human intestine. Many of these produce substances which are in the highest degree toxic. On a high-protein diet, the poison-forming bacteria rapidly increase, giving rise to intestinal autointoxication. German medical authorities have been rather slow to recognize this condition, but Senator, Backmann, Mester, Brieger, Hoppe-Seyler, Krauss, Ewald, Jaffe, Albu, Hirschler, Munch, Rovighi, Grawitz, and others have recognized the validity of the teaching of Bouchard, and have expressed views in harmony therewith.

The writer has for some years pursued studies in relation to this question, and recently by the aid of the improved methods of Herter, Folin, and other recent investigators, has made several observations which seem to have a practical bearing. Five healthy young men were fed upon various diets, as indicated in the tables presented herewith, and a careful study was made of the stools and the urine. In making these studies the stools were examined both chemically and bacteriologically.

The amount of the daily ration was from 1,800 to 2,400 calories. The principal carbohydrates were bread and potatoes. Fat in proportion of about 30 per cent. of the total ration was taken in the form of butter. The protein ration was varied from 125 to 450 calories. Each special dietary was closely followed for five to eight days, and was employed with two or more persons, and in several instances repeated a number of times. The figures given in the accompanying table are the averages obtained from all the observations made, the number of which is indicated in each case.

TABLE VIII.

Showing the Amount of Intestinal Putrefaction as Indicated by the Amount of Indol Found in the Feces and of Indican in the Urine With the Several Diets Indicated.

	Daily Ration in Calories	Gms. of Protein per Kilo of Body Weight	No. of Observations	Avg. Amt. Indol in Feces, No. Mgms.	Avg. Indican in Urine (Folin Scale)
Group I—Moderately high protein diet, 1,00 gram or more per kilo. of body weight	2,187	1.00—1.80	39	1.2270	6.00
Group II — Low - protein diet (vegetable)	2,064	.49—0.96	74	.3611	0.00
Group III — Low - protein diet below Chittenden standard (vegetable)	2,040	.49—0.80	51	.1227	0.00
Group IV—Fruit and cereal diet	2,075	.49—0.70	38	.0567	0.00
Group V — High - protein diet—meat and vegetables	2,200	1.57—1.80	10	1.3508	9.50

It is most clearly shown by the above tables, giving the results of 212 observations, that the amount of intestinal putrefaction is directly proportional to the amount of protein in the dietary.

Beckmann showed the same to be true of white of eggs, but much less so than with meat.

Mester compared fresh meats and "prime" meat with the following result:

		Conjugate Sulphates
1	Ordinary food	0.058
2	Ordinary diet plus meat	0.113
3	Ordinary diet plus prime meat	0.328
4	Ordinary diet plus meat in advanced decay (high)	0.694

In a second series of observations, to each of various food mixtures of equal weight (25 grams) was added a definite quantity (10 grams) of feces which had been previously examined for indol and bacteria. The whole was then placed in an incubator at body temperature for three days. The quantity of indol produced was determined by distillation and testing by Herter's method.

TABLE IX.

Showing the Amount of Indol Produced in Equal Quantities of Various Foodstuffs (25 Grams) Mixed with 10 Grams of Human Feces and Incubated for Three Days.

	Mgms. Indol.
MEATS	
Beef (fresh)	12.42
Pork (fresh)	13.72
Mutton (lean)	17.02
Average	14.39
MILK PRODUCTS	
Unboiled milk	.626
Boiled milk	.520
Yogurt cheese	.126
Average	.426
VEGETABLE FOODS	
Cereals (average of 20)	.055
Raw vegetables	.147
Cooked vegetables	.078
Cooked fruits	.222
Bananas	.404
Average	.181

The table shows that the flesh foods on an average produced nearly eight times as much indol as the average produced by vegetable foods. Milk products produced only 3 per cent. as much indol as meats, while yogurt cheese, made with the *Bacillus bulgaricus,* made less than one per cent. as much indol as meat.

These results are entirely in harmony with the results obtained in feeding experiments, and taken with them show very clearly that foodstuffs which undergo putrefaction outside the body when brought in contact with colon bacteria produce when eaten a very marked increase of the intestinal putrefactions.

Complete Proteins.

Until recently it had been taken for granted that all proteins are essentially alike and capable of replacing one another. It has been learned, however, in recent times, that the protein molecule is very complex, and so variable in composition that the number of proteins possessed of characteristic differences is almost infinite. Every plant produces proteins peculiar to itself, and there are marked differences among animal proteins.

These differences are due to the fact that the protein molecule is made up of simpler bodies known as amino-acids which have been called "building stones" because by different combinations of these foundation elements, the various living tissues of the body are built up. Many different amino-acids have been discovered, some forty or fifty. Less than half of these enter into the proteins of the human body. A protein which furnishes all the amino-acids necessary for building human protein, is known as a complete protein. Such animal proteins as lean meat, eggs, and milk, all contain complete proteins, being of animal origin, and milk and eggs, the yolk at least, being especially prepared for food for young animals. But the proteins of plants differ very widely. Some are complete, but most plant proteins are incomplete. Those foods which the experience of the race has chosen to serve as staples for the feeding of large populations are found by chemical examination to possess the best proteins, that is, those which contain in the best proportions, the "building stones" needed for the repair or construction of body protein.

It is interesting to note in this connection that of the several classes of plant foods, nuts contain the best protein. Researches by Osborne, Mendel, Clapp, Harris, Nollan, Johns, Jansen, Daniels, Loughlin and Cajori, and others have demonstrated that the proteins of nuts are complete proteins. This has been shown to be true of all nuts thus far studied which include the almond, cocoanut, Brazil nut, black walnut, English walnut, butternut, filbert and hickory.

The great cereal staples, wheat, rice, corn, and oats, contain proteins of fair quality. The same is true of rye, and millet possesses a protein of exceptional value. The protein of the potato, another staple, has been shown to be of a superior order. The proteins of ordinary beans, peas, and lentils are of inferior quality; but those of the soy bean and the peanut are equal to those of milk. The protein of the apple is also of excellent quality.

But the incomplete proteins of most vegetable foods are by no means useless. When eaten with foods containing complete proteins, such as milk, eggs, nuts, soy beans or peanuts, their incomplete proteins are supplemented in such a way as to make them satisfactory nutrients. This is one of the most important facts in food physiology, and supplies an important foundation stone for the rational combination of foodstuffs in the construction of bills of fare. It is manifestly essential that care should be taken to insure the necessary intake of complete proteins, and this is especially important when the protein intake is reduced to a minimum.

Sherman has shown that with a cereal diet, the addition of milk sufficient to supply ten per cent. of the protein is sufficient for normal growth and maintenance. This would require a daily intake of about four ounces of milk or an equivalent amount of cheese, say half an ounce to an ounce. Certainly two or three glassfuls of milk daily will supply an ample amount of complete proteins to fully supplement any otherwise sufficient bill of fare.

In the absence of milk, nuts, soy beans or peanuts may be used as complementary foods.

The amount of milk produced in the United States annually is 86,611,000,000 pounds, representing 11,250,000,000 pounds of dry food substance, which is produced by 24,000,000 dairy cattle, each of which requires daily 17 pounds of dry digestible food. That is, 13 pounds of dry digestible foodstuff are required for the production of each pound of dry milk.

There can be no doubt that as meat production diminishes, as it is certain to do, milk production will likewise decrease. There is even at the present time a notable shortage of dairy products, and the average per capita production will undoubtedly continue to decrease from the same causes which inevitably lead to a lessened meat production. Some other source for the complete proteins needed to supplement the incomplete proteins of cereals and roots must be provided. Fortunately, Nature has supplied us with this all-essential foodstuff in that choicest of all food products, the nut. This is a vitally important fact which some time will save the race from protein starvation.

A study of the relative protein content of nuts, milk, and meat shows that, pound for pound, the almond, beech nut, and walnut contain on an average as much protein as does meat and five times as much as is found in milk, and protein which, animal feeding experiments recently made, prove to be of equal value. The chestnut, the chinquapin, the filbert, the hickory, pecan and pine nut contain on an average as much protein as is found in fish; while the butternut, the peanut and pignolia contain twice as much, and 50 per cent. more than is found in the best cuts of meat.

The following table shows the number of ounces of nuts required to furnish the same amount of protein as 4 ounces of milk, the amount required to balance for complete proteins a day's ration of cereals and no milk, eggs or meat:—

TABLE X.

	Amount equal to protein of 4 ozs. of milk (336 cals).	
	Ounces	Calories
Almond	.7	134
Beechnut	.6	116
Brazil nut	.8	165
Butternut	.5	100
Chestnut	1.3	120
Filbert	.9	187
Hickory nut	.9	190
Malted Nuts	.6	91
Pecan	1.4	305
Peanut	.7	85
Peanut meal	.3	33
Pine nut	.6	122
Walnut (black)	.5	94
" (English)	.8	165

Eggs may also serve as supplementary foods, one egg furnishing about the same amount of supplementary protein as a half pint of milk.

It is evident, then, that meat can no longer be regarded as a necessary source of human food, the foodstuffs capable of supplying any real nutritive need which meat can serve, being both diversified and abundant.

The Normal Protein Requirement.

As already shown, the amount of protein needed daily is small, probably about one calory per pound of body weight, that is, normal body weight. A fat person needs no more protein than a person of normal weight for the same height. For the average person this will require 120 to 150 calories of protein.

An examination of the table will show that less than an ounce of peanuts, black walnuts or butternuts will supply as much complete protein as 4 ounces of milk, the full amount actually needed to supplement a bill of fare otherwise sufficient. While an ounce of almonds, beech nuts, filberts, hickory nuts, pine nuts or English walnuts, and less than an ounce and a half of chestnuts or pecans may take the place of milk as a supplementary food. One-third of an ounce of nut meal or twice as much Malted Nuts serve the same purpose.

As a matter of fact, if one eats one or two ounces of nuts or soy beans, an egg, or half a pint of milk, he need give no further thought to the amount of protein he eats provided he does not eat meat, since he will be sure to get enough protein and not likely to get too much.

In a magazine article, Osborne presented the argument that protein is needed not only for food, but for stimulation, it having been shown by Rubner and Lusk that protein differs from other food principles in the fact that it excites the cells to do an amount of work in excess of the energy which it supplies to them. The fact is also mentioned that caffein does the same thing, only in the case of caffein the effect is of course wholly that of excitation, this drug having no food value whatever. Since this effect is purely that of stimulation, no equivalent energy being supplied to support the expenditure induced, it must be regarded as harmful rather than desirable. Rubner has shown that the extra energy thus produced cannot be utilized in useful work, but is a total loss.

Many of the greatest of the ancient philosophers were flesh abstainers, of whom special mention may be made of Herodotus, the father of history; of Pythagoras, the father of Greek philosophy, and of his famous pupil, Socrates, whose scarcely less famous pupil, Plato, was likewise a flesh abstainer, as was also Plutarch, the author of the "Lives." Seneca, one of the most noted of the Roman philosophers, was likewise an exponent of the fleshless diet. Guatama Buddah was a strict vegetarian and required his disciples to discard flesh of all sorts as millions of them at the present time do in India and other Eastern countries.

Advantages of a Low Protein Ration.

The advantages of a lowered protein ration were very clearly shown by experiments conducted with a section of the French Army in 1906. Major P. Joly reports the result of the experiment with two companies numbering respectively 149 and 142 men. It was found that when the four ounces of fresh meat furnished the men was replaced by the same quantity of carbohydrates (cane sugar), there was a decided improvement in their physical condition. They were better able to endure the fatigue of marching, the number of heart beats was diminished, as well as the respiratory movements, and there was less sickness. It was especially noticeable that the men showed less fatigue and were less subject to the depressing effects of heat. During the last three days of the manœuvres, the entire ration of five of the men was replaced by eleven ounces of carbohydrates (sugar) without any ill consequences, the men doing the same work as the others without showing any evidence of fatigue.

The advantage of a low protein diet in maintaining high resistance to disease is shown by the observations of Dr. Reid Hunt, who found that animals fed on a low protein diet were able to resist "two or three times the ordinary fatal dose of acetonitrile" (Chittenden).

Numerous further evidences of the advantages of a low protein ration will be presented in other sections of this work, wherein it is clearly shown that a low but sufficient protein ration is conducive to longevity, to physical and mental endurance, to resistance to disease, and freedom from certain maladies, and that the rigorous restriction of the protein intake to the actual needs of the body is one of the most useful means of combating many obstinate bodily disorders and prolonging the life in cases of incurable organic disease.

The limitation of the protein intake, especially the elimination of flesh proteins from the dietary, is of particular service in the correction of morbid conditions of the intestinal flora. The putrefactive changes which occur in the undigested residues of flesh foods when retained in the colon are now recognized as one of the most active causes of chronic disease. The greatest evils due to errors in diet are those which result from the putrefaction of the unused residues of meats while lying in the colon.

Fats

Fats, like the starches and the sugars, are fuel foods. Their chief function in the body is to furnish fuel to maintain heat and to serve as a source for the energy expended in muscular work, heart and lung work, gland work, and other forms of vital activity. In recent years it has been found, however, that fats are an essential constituent of protoplasm and hence enter into the composition of the living cells of the body. Of this function of fat little is known.

As fuels, fats differ from starches and sugars in that while the latter substances may be termed quick burning fuels, fats instead of being burned at once are stored for future use in the form of adipose tissue, sometimes known as residual or reserve tissue.

In chemical composition fats differ from starches and sugars in the much smaller proportion of oxygen which they contain. For this reason they require a much larger amount of oxygen for their consumption and produce a proportionately larger amount of energy when burned. For example, an ounce of starch furnishes 114 calories of energy, whereas an ounce of pure fat supplies 255 calories, more than twice as much.

There are many different kinds of fats, both animal and vegetable. In the process of ripening of certain fruits and nuts the starch of the green fruit is converted into fat. There is abundant evidence that a similar transformation of starch into fat occurs in the human body.

When starch is taken in larger quantity than is required to furnish the amount of sugar needed to produce animal heat and support the muscles in their work, the surplus is converted into fat which is deposited in the cellular tissue beneath the skin and in other parts of the body.

In the process of digestion, starches of all sorts are converted into a common product, dextrose or grape sugar, which is identically the same in character no matter what the source of starch from which it is formed. In the digestion of fats, however, the case is different, since the products of digestion of fats differ as widely as do the fats themselves. The changes which take place in fats during digestion are essentially the same as those which occur in soap making. The fats are first emulsified, then broken up into fatty acids and glycerine. The fats combine with the potash and soda furnished by the bile and the pancreatic juice to form soaps. After absorption, the glycerine recombines with the fatty acids, thus reproducing the original fat which is deposited in the tissues as such.

The fats of herbivorous animals are much harder than those of carnivorous animals. The fats of fishes and cold blooded animals, naturally have a still lower melting point. A dog fed on mutton tallow becomes fat and his fat is hard like that of a sheep. Such an animal is sometimes spoken of by physiologists as a mutton dog, for the fat deposited in his body is really the identical mutton tallow obtained from the sheep. The same principle, of course, applies to the use of fats by human beings. The true human fat, that is, that made by the body, is formed by the tissues from starch, sugar and other carbohydrates.

Of the several animal fats, beef tallow, mutton tallow, lard, butter and cream, the latter is the most easily digestible. Next in order is butter. Those fats which have the highest melting point are most difficult of digestion.

The vegetable oils are all digested easily and possess about the same value. At least this is true of olive oil, corn, peanut, cocoanut and cottonseed oil. Crisco and oleomargarine are chiefly or wholly of vegetable origin. Nut margarine is prepared from vegetable oils.

While not differing greatly in their digestibility, fats differ much in food value because of their varying vitamin content. The fat soluble vitamin necessary for growth and health maintenance, also to prevent sore eyes and rickets in infants and night blindness in adults, is deficient in most oils, in lard, and in oleomargarine and nut margarine. On this account butter and cream should be preferred as sources of fat when available. It is to be said, however, that a deficiency of the fat soluble vitamin may be made up by the free use of greens which are rich in this food essential.

Fat is not altogether an encumbrance, even when present in slight excess. It is a residual tissue which may be drawn upon in case of food scarcity. The camel's hump serves as a storehouse from which supplies are drawn when other food is not available in its long desert journeys.

Great excess of fat is highly detrimental to health and prejudicial to longevity. Life insurance examiners penalize applicants for insurance when ten per cent or more overweight, because the life expectancy of such persons is known to be below the average.

Ghee, a form of fat much used in India, Turkey and other Oriental countries, is prepared from butter made from the milk of cows, sheep or goats. The butter is boiled and granulated, and though unsalted will keep for many years, even a century or two, according to an authentic record of a find in an old castle in Turkey.

Vegetable Fats.

The principal sources of edible vegetable fats are the following:

Almond	54 per cent.
Avocado	20 per cent.
Brazil nut	61 per cent.
Butternut	61 per cent.
Cacao seed	44 per cent.
Cocoanut meats	36 per cent.
Corn	5 per cent.
Cotton seed	24 per cent.
Hemp seed	32 per cent.
Oatmeal	10 per cent.
Olive pulp	39 per cent.
Palm nut	72 per cent.
Peanut	52 per cent.
Sesame seed	51 per cent.
Soy bean	20 per cent.
Sunflower	22 per cent.
Walnut	32 per cent.

Kernel Oils.

A most excellent vegetable fat is prepared from the nuts of an African palm, the melting point of which is near that of butter, for which it is much used as a substitute. Palm kernel oil is also prepared from the nuts of the cohune palm. It is grown in Central America, where immense forests of this tree are found. In Spanish Honduras and Guatamala the cohune palm forms 20 to 30 per cent. of the vegetation. The nuts grow in enormous clusters nearly as large as a bunch of bananas. The nut is two or three inches in length and an inch and a half in diameter.

The meat, which is about the size of a large nutmeg, contains 40 to 60 per cent. of oil. A tree yields about one thousand nuts annually, from which may be obtained ten quarts of oil. It is estimated that the trees growing wild in British Honduras produce annually not less than 275,000 tons of oil. Other Central American countries are capable of producing a much larger amount. Cohune oil closely resembles the kernel oil of the African palm, though it has a slightly lower melting point.

While these oils are as digestible as butter fat, it is not as yet certainly known whether they contain the essential vitamins, although it is most probable that they are quite deficient in this respect, and hence when used as butter substitutes must be supplemented by liberal quantities of greens which supply the lacking element in rich abundance.

Among other rather unusual oils which recent experiments have shown to be equally as digestible as olive, peanut and other well known oils, may be mentioned oil obtained from apricot kernels, cherry stones, cantaloup seed, peach kernels, pumpkin seed and tomato seed. All these oils were found to be edible and wholesome.

The oils of tomato seed, mustard seed, apricot kernels and of the seeds of the black and white poppy are also used in Italy and in some Oriental countries.

Carbohydrates—Starches and Sugars

The carbohydrate element of foodstuffs consists chiefly of starches and sugars. Many fruits and vegetables contain fruit acids, which are also potential carbohydrates. Lactans and pentozans are found in certain fruits and legumes. These carbohydrates are not utilizable by human beings, although they are apparently readily assimilable by herbivorous animals. Hence, we derive practically all of our carbohydrate nourishment from starches and sugars.

The normal human diet contains about 60 per cent. of carbohydrates, the most of which is starch. The starches are for the most part derived from cereals, but a few roots and vegetables are also rich in starch, particularly the Irish potato, the sweet potato, the manioc root and arrowroot. The taro of the Sandwich Islands and the dasheen, a near relative of the dahlia of our flower gardens, are other valuable sources of edible starch.

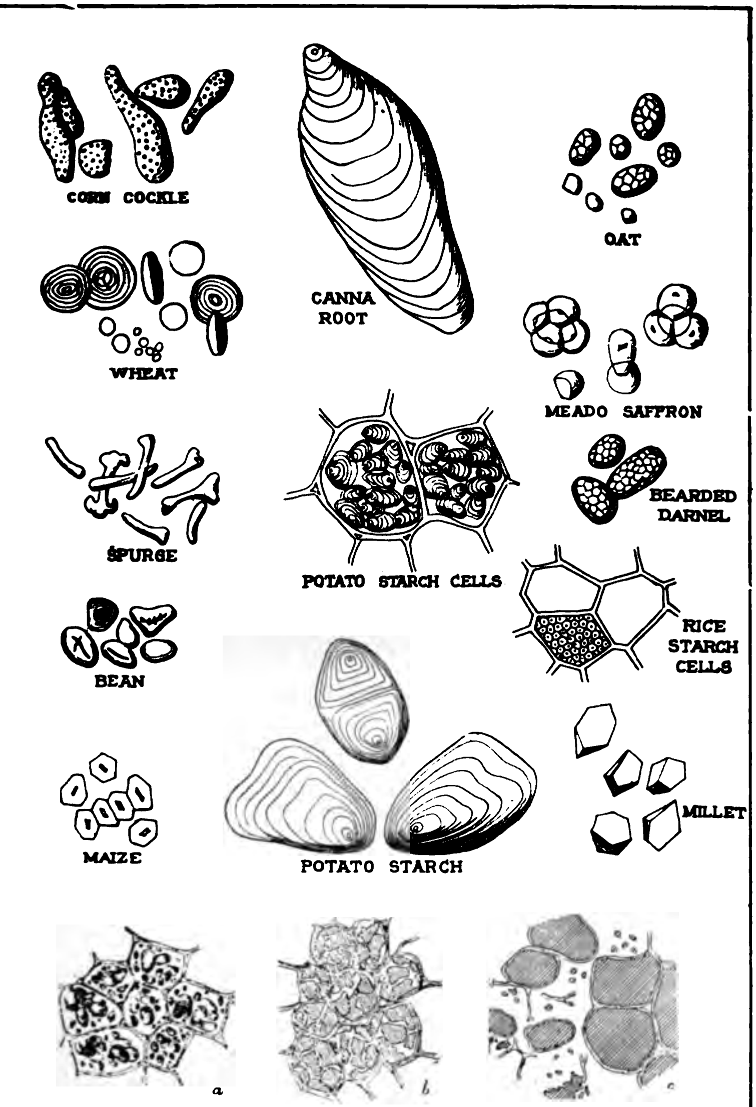
Starch appears in plants in the form of granules which differ in size and appearance in different species of plants.

The accompanying illustrations will give something of an idea of the characteristic appearance of some of the more common forms of starch.

The chemical composition of starch (saccharid) is $C_6H_{10}O_5$. Cane sugar, malt sugar and milk sugar have a similar composition, a single molecule of water being added to two molecules of starch—$C_{12}H_{22}O_{11}$. Glucose and levulose have the composition, $C_6H_{12}O_6$.

Certain vegetables contain peculiar carbohydrates which have the composition, $C_5H_{10}O_5$, called pentosans. By digestion, these bodies are converted into pentoses, a kind of sugar which the human tissues are unable to utilize. Pentoses are found in the urine after the eating of prunes, cherries and grapes. The soy bean contains a considerable amount of pentosans and pentoses, but only a trace of starch.

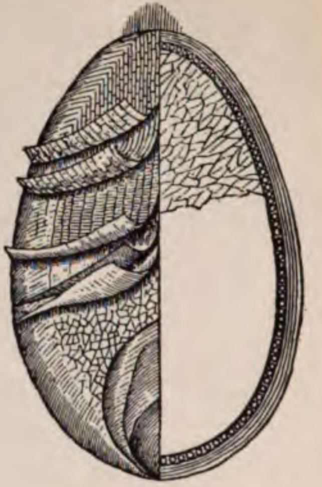
Starch seems to be the form of carbohydrates best adapted



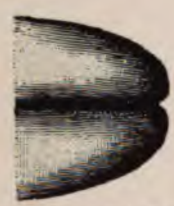
POTATO STARCH. A, RAW; B, PARTIALLY COOKED; C, WELL BOILED.

STARCH GRANULES

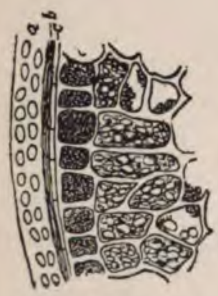
A GRAIN OF WHEAT, MAGNIFIED



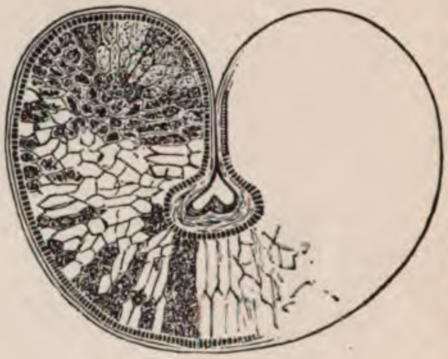
THE DIFFERENT LAYERS OF BRAN.



WHEAT WITH OUTER COAT REMOVED.~



GREATLY MAGNIFIED VIEW OF A SMALL PORTION OF A GRAIN OF WHEAT



INTERNAL STRUCTURE

to the use of human beings. As supplied by the plant, it is insoluble in water and non-absorbable, and must be transformed by the processes of digestion before it can be utilized. Very liberal provision is made for the utilization of starch. Its digestion begins in the mouth, before that of any other food substances. The work of transforming the starch into sugar is continued in the stomach. In the intestine, the starch digestion is carried on by the pancreatic juice and the intestinal juices.

By this arrangement, the sugar formed from the starch is produced and absorbed slowly, so that the blood at no time becomes overcharged with sugar. The normal sugar content of the blood is about one part in one thousand. When this is much exceeded, the kidneys remove the sugar to prevent injury to the blood-vessels and other structures, which would result if the sugar were allowed to accumulate. This explains the appearance of sugar in the urine when large quantities of sugar are taken. If, for example, a half pound of candy or sugar in some other form is eaten at once, within a short time sugar will appear in the urine; but the same amount of sugar taken in the form of starch will never cause the appearance of sugar in the urine of a healthy person. This is the difference between a person in health and a person suffering from diabetes. A diabetic may show sugar in the urine, even though no sugar but only starch has been eaten. But this never occurs in a healthy person, no matter how large a quantity of starch may be taken at one time.

As an additional precaution against a too rapid intake of sugar and its undue accumulation in the blood, the liver is endowed with the special function of capturing the sugar and retaining it within itself by changing it into a form of carbohydrate known as glycogen, a sort of animal starch.

The muscles, also, have the ability to convert sugar into glycogen, and thus a certain amount of carbohydrate is stored up to be utilized in maintaining the sugar content of the blood at its normal percentage during the intervals between meals or longer periods of fasting.

During a complete fast, the store of glycogen is practically used up after two or three days.

Starch has the further advantage over sugar as a carbohydrate food in the fact that it has a neutral flavor, and is bland and absolutely unirritating.

Another advantage possessed by *farinaceous* foodstuffs over sugar is the fact that in this form carbohydrates are not isolated, but are associated with the lime, iron and other salts as well as the precious vitamins, all of which form an essential part of the day's ration.

Some years ago, Grierson made the interesting discovery that there is a marked difference in the digestibility of starch from different sources. Grierson found, for example, that the starch of wheat, corn and rice requires two full hours for digestion, whereas the same quantity of oatmeal starch digests in eighty minutes, and the time required for the digestion of a like quantity of arrowroot starch is but thirty minutes and of potato starch only ten minutes. From which it appears that the root starches are much more easily digestible than are the cereal starches, the starch of wheat, corn and rice requiring twelve times as long for digestion as does the starch of potatoes, and the starch of oatmeal, eight times as long.

The prejudice against starchy food or farinaceous foods which exists in the minds of many persons, even some physicians, is wholly without sound foundation. Of all the elements of our food, starch is the least likely to give rise to inconvenience or to produce harmful effects, even when taken in excess, and the notion that the free use of starch gives rise to rheumatism, to intestinal indigestion, to gastric or intestinal fermentation, or "sour stomach," is wholly baseless. It is of course possible that the dietary may contain a disproportionate amount of starch, so that an individual may suffer for the lack of other necessary elements, but in such cases the bad effects observed are not to be attributed to the starch itself, but rather to lack of other essential elements.

For example, in the feeding of babies, it has long been observed that infants do not thrive on farinaceous infant foods, a long list of which have been offered as safe substitutes for mother's milk and cow's milk; and this has been found to be true even when these farinaceous food products were combined with a considerable proportion of cow's milk sufficient to supply the protein and fat required. It is now known that the chief injury sustained by the child under these circumstances is the result of the lack of vitamins, which are supplied by mother's milk. The child gets all the protein, fat and carbohydrate it needs, but lacks the vitamins which are essential to promote proper growth. In most cases, this defect may be readily remedied by the free of orange or tomato juice.

Daniels and others have recently shown that the growth of babies may be increased by adding to the milk a soup prepared from wheat germs. The notable results obtained are doubtless due to the vitamins contained in the germ of wheat.

The dietaries of adults, when largely made up of farinaceous foodstuffs in their ordinary commercial forms, are equally liable to be lacking in vitamins. For example, fine flour bread, polished rice, the new process corn meal, corn flakes, rice flakes, macaroni, and, in fact, most of the cereals found upon the average breakfast table, are deficient in vitamins.

The hardy Chinese laborer, the gigantic Japanese wrestlers, the sturdy Smyrna porters, the long distance runners of India, the hardy Alpine peasant, all thrive on diets in which natural farinaceous foodstuffs are the staple but which are supplemented by liberal quantities of greens and other foodstuffs which are rich in vitamins.

Hindhede has clearly demonstrated the safety of a highly farinaceous diet by long continued researches which have brought him into great prominence as an author in human nutrition in his own country, Denmark, although they have received little attention in this country. In a letter received by the writer from Professor Hindhede of Copenhagen, a couple of years ago (1919), he said that he then had under observation a man who had subsisted for twenty-three months on a diet consisting exclusively of bread, potatoes and greens. No fat of any sort was added to the foods named, and not a particle of other food had been eaten, yet the subject was in perfect health, vigorous and athletic, and able to engage in the hardest work. Professor Hindhede remarked that he had noted that large quantities of greens were very essential. McCollum, Mendel and others have shown that both cereals and potatoes are deficient in the fat-soluble, growth-promoting vitamin which is supplied abundantly by greens of all sorts.

When much gas is formed in the intestine as the result of eating freely of starchy foods, the cause is not "dyspepsia," but a "bad flora," that is, the presence in the colon of that most mischievous of micro-organisms, Welch's bacillus or an excessive number of colon bacilli. Without lessening the intake of carbohydrate, even increasing it, the gas, though at first increased, disappears as soon as the flora is "changed." This the writer has witnessed in hundreds of cases.

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The Digestibility of Raw Starch.

Observations by Langworthy and Deuel (*Jour. Biol. Chem., May,* 1920) seem to demonstrate that the uncooked starch of corn and of wheat is quite easily digestible, and when eaten by human beings in quantities of ten to twelve ounces are completely digested and assimilated, no trace being found in the feces. In the case of raw potato starch, twenty per cent. remained undigested.

It was noted, also, that the raw starch did not interfere with the digestion of other food principles taken with it although, in the case of the potato, unpleasant symptoms, particularly a considerable formation of gas and "frequent intestinal cramps," were noted.

An interesting observation was that with the potato diet the feces, when heated, gave off no fecal odor but rather an odor of scorched bread, which we take to be evidence of the value of raw starch as a means of suppressing intestinal putrefaction, a matter to which the writer has frequently called attention and on which is based the recommendation to cook oatmeal six to ten minutes rather than longer.

Langworthy's results are in accord with laboratory observations made many years ago (1905) by the writer in experiments with raw starch in which it was observed that raw starch was digestible in quantities of four to six ounces. It was noted, however, that different persons differed in this regard. In the case of one person, most of the starch was discharged undigested, and there was diarrhea with much griping and malaise.

SUGARS

The world's production of cane sugar in 1914 was 42,000,000,000 pounds. Americans use more than any other people.

At the close of the Revolutionary War, the per capita annual consumption of sugar in this country was 7½ pounds. It is now about 90 pounds. The consumption of sugar has increased in this country since 1900 at the rate of one per cent. a year. Diabetes has doubled its death rate in the same period.

Cane sugar was made from bamboo before the sugar cane was used for this purpose. Sorghum has been grown for sugar making in China for centuries. The Indians made sugar from the maple, hickory, birch and watermelon, and the natives of

Mexico prepared sugar from the juice of the century plant in pre-Columbian times.

Of the many sorts of sugar known to the chemist only five enter to any considerable extent into our ordinary dietary. These are *sucrose* or cane sugar, *maltose* or malt sugar, *lactose* or milk sugar, *dextrose* or grape sugar, and *levulose* or fruit sugar.

Of these several sugars we are most familiar with cane sugar, which is derived commercially from the sugar cane, sorghum, beet root, and maple tree. Cane sugar is the sugar of trees, roots and grasses. It is also found in a few fruits, especially certain varieties of the date.

It is an interesting fact that cane sugar is found in the stem of the cherry but in the cherry itself two new sugars appear, glucose or dextrose, and levulose. These sugars are formed from the cane sugar of the sap by a digestive change identical with that which takes place in the human body. When cane sugar is eaten, it is slowly converted into levulose and dextrose, for cane sugar in its native form cannot be utilized by the body. It must first undergo a digestive process, as does starch. But unlike starch, the digestion of cane sugar does not begin in the mouth, but is delayed until the sugar reaches the intestine.

The enormous consumption of cane sugar in this country, four times that of many other civilized countries, and the growing prevalence of the candy habit as the result of the diligent fostering of the practice by energetic manufacturers, justifies the inquiry whether or not the present extravagant use of the sugar of commerce is wholesome or safe.

Atchison Robertson (22), in carrying out a series of experiments, injected 250 c.c. of a 20 per cent. solution of sugar into the stomach of a patient who was suffering from chronic gastric catarrh. "Shortly afterward the patient became sick, and vomited a very acid fluid which put his teeth on edge. He also complained of heartburn and flatulence, and of a severe pain in the region of the stomach." Another experiment was the injection of a solution of fruit sugar (levulose) of the same strength, which produced no discomfort. The experiment was repeated with similar results in other cases of dyspepsia, and in every case the invert sugar produced no unpleasant symptoms. Schule found that from two to six lumps of cane sugar, when taken in an ordinary test breakfast, produced no appreciable effect on the digestion, but when the quantity was increased from ten to twenty lumps, considerable delay of digestion ensued, by reason of "the great outpouring of mucus in the stomach."

Brandl, an eminent German chemist, observed, in experiments upon a dog, that a solution of cane sugar having a strength of less than six per cent., cause irritation, with reddening of the mucous membrane. A ten per cent. solution produced a dark red color with great irritation; and a twenty per cent. solution gave rise to still greater irritation, and produced such distress that the experiment was terminated. The author has met many cases of grave stomach disorder in which evidently the chief cause was the free use of sugar either in the form of candy, or in connection with the use of coffee, oatmeal mush, or other "breakfast foods."

Ogata, in experimenting upon dogs for the purpose of determining the effects of cane sugar upon digestion, observed that the addition of one-third of an ounce of cane sugar to a meal of meat reduced digestion one-fourth.

The Germans made years ago extensive experiments with sugar as a means of supporting muscular work, extending their experiments to horses and other animals as well as soldiers. They found that while the sugar showed remarkable sustaining qualities, it was impossible to use more than a comparatively small amount on account of the irritating effects upon the stomach.

Sugar is freely used by rowing clubs in Holland, and it is reported that it seems "to counteract the bad effects of a meat diet so that the dreaded symptoms of overtraining did not appear." This fact is very interesting as an indication that the effect of overtraining is due to the large quantity of meat consumed. Sugar is antitoxic. When freely used it not only lessens the amount of meat consumed, because of the limitation of the calory intake, but also through its antitoxic influence combats intestinal putrefactions encouraged by a heavy meat diet.

Molasses is much used in sugar-producing regions as food for horses and dairy cattle. The so-called black strap molasses is commonly fed in quantities of 8 to 12 pounds per head. As a food a good quality of molasses is preferable to sugar for the reason that it is rich in iron and lime.

Malt sugar. There is found in grains ferments or diastases similar to the ferments of the saliva, which are capable of first liquefying starch and then converting it into sugar. These ferments become active in the process of germination, and by the conversion of the starch in the seed furnish food for the young plant. Sprouted or malted barley has long been used in civilized countries for the conversion of starch into sugar in the manufacture of beer. The same process of sugar making has been employed in Japan for at least two thousand years. The Japanese make from rice, corn, millet, and sweet potatoes a preparation which they call *ame*, a sweet substance which appears in the form of a thick amber colored liquid and also in hard, white masses resembling candy. Ame is much used in Japan, and was in common use there hundreds of years before cane sugar was known in Europe.

Dextrin is a product intermediate between starch and dextrose. The chemical composition of the three substances is essentially identical, except that in the change from starch to sugar, water is added to the molecule. Dextrin is found in plant juices and fruits. It is present in glucose and in malt sugars to the extent of about 30 per cent. Dextrin may be produced not only by the digestion of starch but by the action of mineral acids and by heating at proper temperatures. The crust of bread and the browned portion of toasted bread contain dextrin. Dextrin has been recently shown to have special value as a means of changing the intestinal flora. When it is taken in doses of three ounces three times a day for several days in succession (7-10 days), the putrefactive flora disappears and acid-forming bacteria become dominant. The stools cease to have a putrid odor.

Dextrose or *grape sugar* is the sugar of grapes. It is found in most fruits with levulose in about equal quantities. Dextrose is formed from starch and from other sugars by the process of digestion and may be produced from various carbohydrates by chemical processes. All the sugars of foods are converted into dextrose before they are utilized by the body. Dextrose is the chief source of bodily energy. It is the body fuel *par excellence*.

Glucose is a saccharine product prepared by boiling cornstarch with a dilute mineral acid until the starch is partially converted into dextrose. It contains both dextrose and dextrin. So-called brewers' sugar is a form of glucose containing about 70 per cent. of dextrose. What is known as "80 sugar," or "acme sugar," contains 80 per cent. of dextrose. Practically all the cheaper grades of candy, and probably some of the higher grades, consist very largely of glucose. This is a cheap form of sugar about half as sweet as cane sugar.

Malt Sugar Superior to Cane.

It has been experimentally determined (Hammond), in the feeding of infants, that an infant is able to oxidize half a dram of lactose per kilogram of body weight, or practically one-fourth dram per pound. If the quantity is increased 50 per cent. beyond this, sugar appears in the urine. The same is true when cane sugar is fed; but in the case of malt sugar, more than three times as much sugar may be given before sugar appears in the urine. In other words, malt sugar is utilized by the infant more than three times as well as is milk sugar or cane sugar. From this it clearly appears that malt sugar is greatly preferable to any other form of sugar as a foodstuff. Cane sugar, the sugar of grasses, is adapted to the digestive organs of herbivorous animals. One of the four stomachs of ruminants supplies a ferment which quickly converts cane sugar into dextrose and levulose, the sugars found in fruits.

Malt sugar has many advantages over cane sugar. It is non-irritating, being native to the body, since it is constantly formed in the digestion of starch. Malt sugar also contains lime, iron and vitamins, all of which are lacking in cane sugar.

The manufacture of malt sugar for food was initiated by the writer nearly thirty years ago. The enterprise was undertaken for the purpose of obtaining a palatable product which could be eaten in quantity, the malt extracts of that period being quite unpalatable because of their bitter flavor. For more than twenty years some tons of the sugar in dry and liquid forms have been made annually and supplied to a few medical institutions. Recently the high price of cane sugar has led to the development of a considerable malt sugar industry in this country. In the process of beer-making, the starch of grain is first converted into malt sugar, by the action of the diastase of malted barley, and then beer is produced by the fermentation of the wort. Since the establishment of prohibition, some of the great brewers and distillers of the country have gone into the business of making malt sugar. Their great fermenting vats have been replaced by vacuum pans and other apparatus by which, after the sugar is produced in solution, the water is removed and malt sugar in the form of a syrup or a powder is produced.

Reid has shown that maltose enjoys an additional advantage over ordinary sugar in that it is absorbed much more rapidly. This is especially true when the mucous membrane is diseased, as in intestinal catarrh. In such conditions the absorption of maltose is eight times as rapid as that of cane sugar. This fact explains the observation often made by physicians that patients who are easily able to eat farinaceous foods freely without difficulty and can even take malt preparations in very considerable quantity without experiencing any inconvenience, may be unable to eat the smallest amount of cane sugar without suffering seriously in consequence from formation of gas in the intestines as the result of fermentation, the slow absorption of the sugar, giving the bacteria an opportunity to act upon it.

Levulose is the sugar of fruits, and is often called fruit sugar, although dextrose is as truly a fruit sugar as is levulose. In most fruits these two sugars are found in about equal amount. Levulose is formed from cane sugar by the process of digestion. It is converted in the body into dextrose before it can be utilized. Honey consists of about equal parts of levulose and dextrose.

Levulose has been shown to be better tolerated by some diabetics than is dextrose and other sugars and on that account is sometimes very useful in the treatment of cases of diabetes.

Manna, a sweet substance which from the most ancient times has been gathered from certain shrubs growing in the Sinai desert, owes its sweetness to *mannite,* a sweet substance but not a true sugar. Manna is still gathered from the same locality where the ancient Hebrews found it in their wanderings and may be obtained from any drug store. It is slightly laxative and on this account is used medicinally. Quite recently a sweet substance said to be manna has been occasionally found in considerable quantity on the foliage of the Douglas fir tree in British Columbia. It forms on the leaves in drops as large as peas, and sometimes in larger masses.

Mannite differs from cane sugar in that it is not fermented by yeast. It is somewhat laxative and may be used without injury by diabetics, since it does not increase the sugar of the urine. It is found in the beet root and in the sweet juice of the ash tree.

A sugar known as inosite or American manna is obtained from the sugar pine. It exudes from the heart of the tree and collects on wounds which have been produced by fire, the axe or otherwise, forming irregular masses of a brittle, white substance having much the appearance of candy. It is sweet to the taste and is as well relished by many people as is maple sugar, but one's appetite for it is quickly satisfied. Chemical examination of this material, however, shows it to be quite different from the sugar of the cane and the maple tree. It does not ferment with yeast as does sugar, and though sweet in flavor is not really a sugar. Neither is it the true mannite which is found on the Douglas fir and on the shrubs of the Sinai desert. It is used as a medicine by the California Indians.

Lactose or Milk Sugar.

Lactose or milk sugar is a form of sugar peculiar to animals. It is in this respect unique, being found only very rarely in the vegetable kingdom. It is of all sugars the most difficult of digestion and assimilation. It has the least tendency to ferment of any of the sugars, although it is readily fermentable by the milk-souring bacteria which are always found present in the intestines of a healthy infant within a few hours after birth.

Experiments have shown (von Noorden) that lactose is utilized only one-fourth as readily as is maltose, the sugar formed by the digestion of starch.

The value of lactose as a means of encouraging the growth of protective organisms in the intestine is due to the slowness with which it is utilized, permitting it to find its way into the large intestine where its presence is necessary to promote the growth of acid-forming bacteria.

The lactose of milk clings to the casein of the milk, from which it can be separated only by repeated washings. This fact contributes greatly to the success of the milk regimen—which floods the intestine with curds which carry milk sugar into the intestine and there feed the friendly bacteria. Advantage is taken of this fact in reference to changing the intestinal flora. It is found that if a person takes nine or ten ounces of milk sugar in three portions, during the day, for a few days in succession, the stools quickly lose their putrid character and the protective organism known as the *bacillus acidophilus* makes its appearance, while putrefactive organisms disappear. Similar results follow the use of three pints of acidophilus buttermilk daily.

Dates vs. Cane Sugar.

There is no doubt that the American people are suffering greatly from the excessive use of cane sugar. Cane sugar differs from the natural sugar found in dates in several important particulars. In the date the sugar is associated with other essential food constituents, especially protein, which is necessary for tissue building, iron, which is essential for the blood, lime, which is essential for the bones, and vitamins, another highly important food constituent necessary for the maintenance of nutrition and to stimulate growth and development in the young; all these food essentials are found in the date but none are present in cane sugar. Consequently, when a person uses sugar freely he is certain to suffer from a deficiency of lime, iron and vitamins, as the result of which he is likely to be anemic and to suffer from muscular weakness and lack of tone, as well as from an unhealthy state of the bones and decay of the teeth.

Another disadvantage of cane sugar arises from the fact that it is not that form of sugar to which the tissues of the human body are best adapted. Sugar (dextrose) is the fuel of the body, but not cane sugar, which is sucrose. The body uses invert or digested sugar. It cannot make use of cane sugar until after it has been digested. The process of digestion is always slow and often difficult in the human body, although in herbivorous animals the digestion of cane sugar is liberally provided for by a stomach especially adapted to the purpose. The sugar of dates, with the exception of a few varieties, is invert sugar; that is, sugar which is already digested and ready for immediate absorption and utilization. The cane sugar of the green date is during the process of ripening changed to invert sugar. The more mature the fruit, the more complete is this transformation. A similar transformation takes place in other sweet fruits. In the Deglet Nur and one or two other varieties of date, this change from cane sugar to invert sugar is not completed and these varieties of date contain much cane sugar rather than the more desirable invert sugar.

Cane sugar has the great disadvantage that it is irritating as well as difficult of digestion. If taken otherwise than in very dilute form it is likely to produce severe irritation and may give rise to ulceration. The use of cane sugar is a common cause of gastric catarrh and hyperacidity. It is believed by many authorities that the free use of cane sugar is a cause of diabetes. It is most desirable that the consumption of cane sugar, which is carried to great excess in this country, should be greatly lessened. The substitution of dates, especially of the invert sugar varieties, should be encouraged. The date is more than a wholesome substitute for sugar, it is a whole food. It may be used as freely as may be desired and without injury. Observations made by Metchnikoff show that by the free use of dates the intestinal flora may be changed; that is, the poison-forming putrefactive bacteria may be suppressed and the harmless protective acid-forming bacteria made to grow in their place. An ounce of dates contains more food iron than an ounce of beefsteak.

Substitutes for Sugar.

The only substitutes for sugar thus far found have been certain coal tar products, chief of which is saccharine, which is 280 times as sweet as cane sugar. This substance has been much used until recently as a substitute for sugar by certain manufacturers and by persons suffering from diabetes. It has been constantly under suspicion, however, and recently (1920) Professor Heitler, a well known authority on heart diseases, has published the results of a research which shows that, while sugar stimulates the activity of the heart, saccharine depresses it. The heart is gradually weakened by its use.

Saccharine belongs to the great family of coal tar products, many of which are active heart poisons, hence it is not surprising that careful observation has shown it to be a highly injurious drug. An experiment made some years ago in this country showed that it might be used in minute quantities for some time without producing disturbance of digestion, but apparently the effects of the drug upon the heart were not studied. Certain manufacturers relying upon the report of the goverment committee, have conducted a widespread campaign intended to promote the use of saccharine, and these efforts have been greatly aided by the recent extraordinarily high price of sugar. Now that the facts are known, it is highly important that the information should be spread abroad as rapidly as possible.

When saccharine is used in larger quantity than one or two grains three times a day it causes disturbance of the stomach.

Cane sugar, when freely used, is often productive of great injury, but to substitute for cane sugar a coal tar product such as saccharine, is to jump from the frying pan into the fire. The proper thing to do is to restrain the appetite for sugar. Sugar, as such, was unknown to our remote ancestors, and was doubtless disliked by many of them as by many persons at the present time. The sugar-eating habit may be acquired like the tobacco or the alcohol habit or the habit of chewing gum. It is a habit which should be combated.

A fortunate discovery by the U. S. Bureau of Plant Industry may lead to a solution of the sugar substitute problem. When in Washington, some months ago, the writer was shown a specimen of dried leaves from a plant which grows wild in Paraguay, which contains a substance 180 times as sweet as sugar. This curious plant is known as *kaa lee* by the natives of Paraguay. Another strange plant obtained from Nigeria bears a fruit which, although but slightly sweet itself, possesses the remarkable property of imparting to such sour substances as limes, lemons, or even vinegar, an intense sweet flavor which is retained for several hours.

The best solution of the problem is to be found in the education of the appetite away from sweets. The American sugar tooth has acquired enormously overgrown proportions and should be rigorously restricted in its indulgence in sweets and confections.

The Nation's Candy Bill.

The United States consumed in 1919 an average of 13.1 pounds of candy per capita (Financial World) at a cost (retail) of $1,219,000,000.00, an increase of more than 1,000 per cent. in forty years.

Most candies contain a large per cent. of glucose. Some years ago Roger reported the results of a series of experiments conducted by him for the purpose of determining the influence of various substances upon the protective power of the liver against infection. He found that "large doses of glucose, given by mouth, weaken the protective power of the liver." This fact unquestionably explains the observation made by many persons that the free use of candy makes them "bilious."

The use of candy and of cane sugar in other forms should be forbidden in all deficiency diseases such as scurvy, beri-beri and pellagra, as well as in cases in which lime and iron are deficient.

Bergeim, Rehfuss and their associates found that both cane sugar and glucose when freely used, diminished the secretion of gastric juice and delayed the emptying of the stomach. It is evident that cane sugar must be avoided in all forms of gastric disease and especially in gastric catarrh, gastric and duodenal ulcer, hyperacidity and gall bladder disease. The excessive use of cane sugar is believed by many able clinicians to be the cause of diabetes. There are many cases of persons who are on the border line of diabetes, potential diabetics. Examination of the urine in such cases shows no sugar, but Bergell's reaction is positive. A chemical examination of the blood shows a high sugar content. Such cases should wholly avoid cane sugar and should greatly lessen the intake of carbohydrates in any form.

Honey.

It is quite possible that good results would follow the exchange of at least a considerable part of the cane sugar we consume for honey. This natural sweet is prepared from the nectar of flowers. It is said that the nectar from 62,000 clover blossoms is required to produce one pound of honey, and that 3,700,000 visits of bees are required to gather it into the hive.

The sugars of honey are levulose and glucose in about equal parts, mixed with flavors from the flowers and formic acid from the poison bag of the bee. The latter is deposited in the filled cell before capping to prevent fermentation. Some persons are sensitized to honey and cannot make use of it. Honey is unwholesome when gathered from poisonous plants.

Some Odd Sugars.

There are numerous sorts of sugars, some of which would hardly be recognized as real sugars. The people of various countries produce sugars in great variety. The Greeks prepare sugar from currants; the Arabs make sugar from the palm, the date, the karob bean and the raisin. In Mexico and South America brown sugar is put up in loaves of various sizes, large and small, and is often of better flavor than the brown sugar of this country.

Food Salts

In addition to starch or sugar (carbohydrates), fats and protein, complete foods contain certain organic salts which are essential to life and health. Kellner fed animals food from which the salts had been extracted and they all died, and sooner than animals that had no food at all.

The principal salts, which should be always abundant in the daily bill of fare, are potash, soda, lime, magnesia, and iron. Phosphorus and chlorine are found in combination with the alkaline elements. Recent researches indicate that iodine is also a necessary constituent of the food and that zinc, which is present in foodstuffs in nearly the same proportion as is iron, may possibly be a valuable factor in nutrition. The iodine content of foods is a matter of importance especially in diseases of the thyroid gland.

An eminent French chemist, M. Guerithault, recently (July 19, 1920) communicated to the Academy of Sciences a report of an investigation of the copper constituent in plants. He finds copper present in varying amounts in "The leaves of lettuce, spinach, leeks, and celery; the roots of the carrot, turnips, radish, salsify, leeks, beets, and cress and the stalks of the latter; bulbs of onions and the tubercles of potatoes; in green beans; in the fruits of the pumpkin, cucumber, tomato, apple, pear, cherry, grape, orange, olive, banana, date and chestnut; and in the seeds of peas, beans, soy beans, lentils, wheat, barley, rye, oats, maize, cress, radish; as also in decorticated rice and in various nuts, including sweet and bitter almonds, walnuts and hazelnuts."

The lime and iron of the food, with other salts, are closely associated with protein in vegetable tissues. In animal tissues the lime is found almost exclusively in the bones and the iron in the blood. The almost universal neglect in this country to provide a constant and abundant supply of food salts in the dietary renders this subject sufficiently important to justify a somewhat detailed discussion of it in the interest of food reform and race betterment. For many years the importance of food salts has been recognized in the writer's work at the Battle Creek Sanitarium, and a few years ago he worked out a plan by which the lime and iron constituents of the diet, and incidentally other food salts, may be as easily "balanced" as are the carbohydrates, proteins and fats, the balancing of which for each patient has long been a part of the Battle Creek Sanitarium diet system.

In general it is sufficient to make sure that the food contains a sufficiency of lime and iron. When these elements are present in sufficient amounts the other essential salts are practically certain to be present also.

THE IRON RATION

By the term, "iron ration," is meant the necessary daily intake of food iron, or so-called organic iron found in ordinary foodstuffs in varying proportions.

Iron is one of the essential constituents of the body. It is found in all living organisms, both animal and vegetable. Its importance to the growing plant has long been recognized by scientists, and is evidenced by the fact that iron abounds in the germ of cereals and other seeds. It is for the same reason, doubtless, that iron is found in relatively large amount in the embryos of animals, as in eggs, particularly the yolk of the egg. Iron is essential to life from the very outset.

In the animal body, the chief function of iron is to supply and maintain the hemoglobin of the blood, which is an organic iron compound peculiar to animals, and possesses a special chemical property by means of which it is able to absorb and condense oxygen (1.3 times its volume).

This iron-containing hemoglobin is the chief constituent of the red blood corpuscles. Without iron, the body cannot make hemoglobin and hence cannot make blood cells, one of the most highly essential of all the bodily tissues.

The essential character of the blood seems to have been known from the most ancient times, even when the arteries were supposed to be carriers of air. Said the old prophet, "The blood is the life," a dictum which John Hunter's famous experiment proved to be the expression of a profound scientific truth.

The twenty-five million million red cells floating in the blood stream of a man of average size, have a combined area of about 22,000 square feet, or one-half an acre.

The life of a red blood cell is only about six weeks; hence, of the 25,000,000,000,000 oxygen carriers, 7,000,000 die every second of our lives, and to keep the number intact, 7,000,000 new red corpuscles must be created by the living forces of the body every second, one of the most striking illustrations of creative power at work with which science has made us acquainted.

It has been observed that plants often suffer from anemia, their leaves are pale green and the flowers lack brilliance of color. This condition may in many cases be remedied by the administration of iron. Water containing iron rust poured about the roots of the plant, or even iron filings mixed with the soil about the plant, will often produce a rapid change for the better; the foliage becomes deep green in color and the tints of the flowers become more pronounced. In some instances pink hydrangeas have been made to produce blue blossoms.

When the iron supply is deficient and the blood is depreciated, the face, lips, gums and finger nails become pale because the red blood cells are reduced in number. In normal blood, a minute cube, half a line in diameter, contains not less than 5,000,000 red corpuscles with half a square inch of absorbing surface. This number is greatly reduced in anemia, the blood count becoming 3,000,000 or 1,000,000 or in very pronounced cases falling as low as 500,000 or even lower. This means that the oxygen-absorbing and carrying element of the blood, that is, the hemoglobin, has been reduced in proportion. Instead of 21,000 square feet of oxygen-carrying surface, there are only 15,000 or 4,000 or even 2,000 square feet, a reduction to one-tenth the normal amount.

This explains why an anemic person is short of breath, even when there is no trouble with the heart or lungs. He pants when he goes up stairs. He cannot run or even walk fast for a short distance without getting out of breath. There is nothing wrong with his breathing apparatus. The air is taken into the lungs properly and it comes in contact with the blood, but the blood does not take up enough oxygen because it is deficient in hemoglobin and so cannot absorb the oxygen brought to it, the effect being just the same as though the air supply were in part shut off by disease or by injury to the lungs.

The anemic person lacks appetite because food is fuel and the oxygen which the iron-containing hemoglobin brings is necessary to burn up the incoming supplies of fuel and to prevent the accumulation of unused and clogging material in the tissues.

The anemic person becomes sallow and the skin is often pigmented as well as pale, because the oxygen supply is insufficient to burn up the wastes of the body and they accumulate in the tissues.

A person whose blood count is low feels languid and weak, because oxygen is needed to release the energy supplied by the food and stored up in the muscles and other organs.

In anemia all the life processes are depreciated, every vital function is crippled, and the whole body is depleted. Long continued anemia of a severe type may give rise to paralysis as the result of damage to the spinal cord.

Plants as well as animals suffer when iron is deficient. The leaves become pale and the flowers lose their brilliant coloring. By watering the plants with rusty water or mixing iron filings with the soil, the normal colors of leaves and flowers are quickly restored.

In view of the great importance of iron in the life activities of the body, it would naturally be expected that it would figure large in amount among the constituents of the tissues. But the very opposite is true. It is the very smallest in amount of the twelve principal elements which enter into the composition of the body.

As will be seen by reference to the table (p. 27), the entire body contains only one-tenth of an ounce or one part of iron in 24,000 parts of body weight. This proportion is about the same as that of a teaspoonful of flour compared with a barrelful. There are hidden away in the bones 500 times as much lime as there is iron in the whole body; and yet, this minute amount of iron, 44 grains, is just as essential as the oxygen which forms two-thirds the total weight of the body, or as the carbon and other elements which make up the balance.

Iron is found in the body almost exclusively in the form of hemoglobin, the red coloring matter of the blood. The blood constitutes about 7 per cent. of the body weight and contains about ninety-five per cent. of the iron. The red color of a piece of raw beefsteak is due to the blood in it. By thorough washing in salt water the blood may be removed and the muscle tissue left will be found nearly white in color.

Iron is found, practically, only in the blood because it is through the circulation of the blood that the iron is made to do its peculiar and wonderful work in entrapping the life giving oxygen and circulating it throughout the body to every minute cell and tissue, bringing it in immediate contact with the most minute waste particles, and carrying back to the lungs the used up materials, the products of combustion in the form of carbon dioxid (CO_2), by far the most bulky and the most important of all our excretions, amounting to more than half a pound daily, or more than forty times the weight of the urea eliminated and four hundred times the weight of uric acid excreted.

And the elimination of this enormous mass of poisonous debris all depends upon a few grains of iron in the blood. When a person is submerged in water he drowns in three or four minutes because of inability to get the carbon dioxid out of his blood. The blood and tissues become saturated with the poison and the body cells are asphyxiated. A man who has an insufficient amount of iron in his blood is like a half drowned man. The CO_2 accumulates in his blood and tissues and the living cells become crippled and incompetent.

The Daily Requirement of Iron.

The solid as well as the liquid materials which enter into the composition of the body are in a state of perpetual change. An eminent scientist defines an animal as, "A stream of matter flowing through a certain form." The fluids of the body change very rapidly; the soft parts, quickly, though less rapidly, and the solid parts more slowly. For example, the daily loss of lime is only ten or twelve grains, at which rate nine years would be required to exhaust the body's store of 4.6 pounds of lime (CaO). The blood, as already noted, loses all its red cells and replaces them by new ones about once in six weeks according to the estimate of physiologists. This would involve a loss and renewal of practically the entire iron store of the body every six weeks. But nature is less extravagant in her expenditure of iron than in the disposal of her store of lime. She hoards the precious metal with the greatest care. The worn out bodies of the seven million red cells which perish every second are carefully worked over and the iron contained in their hemoglobin is recovered and stored in the liver and spleen and used in the making of new cells to take the place of those which are lost. Of course there is some loss of iron, but instead of losing a grain a day the actual loss of iron from the body is only about one-seventh of one grain.

We need food iron to make good this loss. Small though it is, it must be made good, or the direst consequences will follow. Animals fed on a diet which contains no food iron die in a month or less.

To make certain that the supply of iron is adequate, the physiologists tell us that we require not less than .213 grains, practically one-quarter of a grain, per diem. The iron ration for the maintenance of health may be said, then, to be one-quarter of a grain of food iron daily.

Women require a larger intake of iron in proportion to their weight than do men, and infants and children need much more than adults. The functions associated with childbearing and nursing make a special demand for iron which requires an iron ration for the average woman fully equal to that needed by the average man of greater weight.

The expectant mother must supply iron for the blood of her infant, as well as for storage in its liver, from her own blood. In other words, the mother must furnish from her own store of blood iron, iron enough for blood-making purposes to meet the needs of her infant not only before birth but for a whole year afterwards, at the end of which time its blood volume and its weight are three times as great as at birth.

The monthly function of women involves a loss of iron which must be made good through a diet especially rich in organic iron. Even before puberty, girls require food richer in iron in proportion to their size than do boys for two reasons:

(1) Because they grow faster than boys, becoming taller and heavier between the ages of 12 and 15 years than boys of the same age.

(2) Because they usually eat less than do boys of equal age.

It is perhaps for this reason that women, guided by instinct, are notably more fond of greenstuffs and salads and fresh vegetables than are men. This natural tendency should be encouraged. Women and girls should eat more freely of greens of various sorts and of all foods rich in iron than do men and boys. Lentils, dates and malt sugar are rich in iron. See p. 170.

The popular notion that cow's milk contains everything needful for nutrition is an unfortunate and dangerous error, though one into which a person very naturally falls. Milk is a natural food and is intended for animal sustenance and is primarily intended to be used as an exclusive diet, but it must be remembered that it is only sufficient as a complete nutrient when fed to very young animals which have been provided by nature with an extra supply of iron stored up in their livers before birth.

A guinea pig becomes anemic and starves on an exclusive diet of cow's milk. The same thing happens to a human adult if the diet is too long continued. Neither the guinea pig nor the human adult has a reserve of iron suitable for blood-making sufficient to last more than a few weeks.

This question becomes one of very great importance in the artificial feeding of infants. According to the best authorities on the chemistry of foods, human milk contains twice as much iron as does cow's milk. This fact insures the nursing infant an adequate supply of iron during the nursing period. A very striking illustration of the marvelously wise adaptations of means to ends in the economy of nature is afforded by the difference in the composition of human milk and cow's milk. Cow's milk contains nearly four times as much lime to the ounce as does human milk, but only half as much iron. The reason for this striking peculiarity is found in the fact that the calf needs four times as much lime for the formation of bone because it reaches maturity in less than one-fourth the time of the human infant, while, on the other hand, it needs less iron in its maternal food supply because it begins to nibble grass, like its mother, a food very rich in iron, within a short time after its birth; whereas, the human infant normally is nourished exclusively by its mother's milk until six months of age or older.

When infants are fed other food than mother's milk the management of their diet becomes a matter of exceeding delicacy. It is more than probable that few if any artificially fed infants escape injury more or less serious through an inadequate supply of iron or lime or vitamins or of all these elements, or from lack of balance in the bill of fare in some other particular.

In the feeding of infants experience has shown the necessity for the dilution of cow's milk and the best results are secured by diluting whole milk with water, sweetened with milk sugar or malt sugar. In feeding young infants, equal parts of milk and water are generally employed. An infant fed on such a mixture receives only one-fourth the amount of iron normally found in human milk. On such a diet, the child becomes anemic. Resistance is lowered and the infant becomes subject to a great variety of disorders, the effects of which may remain through life. The free use of orange juice, the use of malt sugar instead of milk sugar and the use of barley meal, malt soup, lentil soup, and soups prepared from spinach and other green vegetables and foods rich in iron, in connection with milk feeding, are measures, the value of which has been little appreciated until recent years. It is probable that the deficiency of iron in some infant dietaries is to some extent compensated by an excess of lime; at least some recent observations would indicate that this may be the case.

Where to Find the Necessary Food Iron.

Experiments made upon animals (Hall) show that when the food contains no iron at all, 40 per cent. of the entire iron content of the animal's body may be lost in three weeks.

How may the daily requirement of iron be best secured? This would seem to be an extremely simple problem for no one of all the metals is so abundantly scattered over the face of the earth and in the earth and all about us, facing us at every turn, as is iron, and formerly it was supposed to be a matter of entire indifference in what form the iron was received so long as it was gotten into the body.

More than a third of a century ago Bunge of Bâle, Switzerland, one of the most eminent of those of the world's chemists who devote their lives to the study of the chemical problems relating to the human body, undertook, with the aid of his students, an extended series of experiments for the purpose of settling the question whether the ordinary iron with which we are familiar, the so-called inorganic iron or any of its compounds could be utilized by the body in keeping good its stock of iron for use in blood making.

First of all, Bunge showed that natural foodstuffs contain iron in a peculiar state so different from that in which it is found in various chemical compounds and minerals that it cannot be recognized by the usual chemical tests for iron. This is known as organic iron. Bunge found in the yolks of eggs considerable quantities of this organic iron (hematogen) which was so similar to hemoglobin as to be easily converted by the body into the coloring matter of the blood, one of the most remarkable of all organic substances. Similar compounds were found in milk, legumes, and in cereals, as well as in the yolk of eggs.

In experiments upon a large number of rats, rabbits and dogs conducted in Bunge's laboratory it was found that the animals supplied with foods rich in organic iron made twice as much hemoglobin as those which were supplied with inorganic iron. It was also noticed that foodstuffs contain iron only in the organic form, "built up by the life processes of plants." This organic iron, according to Bunge, is the source of the iron used by the body in the formation of hemoglobin. The observations of Bunge have since been confirmed by many other investigators.

One observer has shown that rabbits made anemic by bleeding, recovered when given chlorophyl much more rapidly than when given inorganic iron.

It is doubtless true, as suggested by Von Noorden and others, that inorganic iron may temporarily stimulate the blood-making process, but apparently it cannot be used, at least to any extent, in the construction of red blood cells. This stimulating effect of chemical iron preparations may be of some possible advantage in certain cases of disease, but the stimulation produced is of very short duration, and on this account such iron preparations should be employed only for very short periods, if at all. As a matter of fact, they are rarely useful and very seldom needed. The long continued use of inorganic iron in the form of medicine or mineral waters is detrimental, causing constipation and other disorders. To prevent injury to the tissues, the liver, exercising one of its most important protective functions, captures the inorganic iron and holds it in its own tissues until it can be disposed of. This unnecessary work demanded of the liver may seriously interfere with the performance of some of its highly important functions. Thus the long continued use of inorganic iron in mineral waters or otherwise is to be condemned.

The iron ration, then, must be drawn from organic sources; that is, it must be obtained from natural foodstuffs. Chemical, or inorganic iron, even though possibly of some limited service in certain cases of disease, is no proper substitute for food iron. As Sherman well says, in summing up the world's most eminent authorities, "Inorganic iron when absorbed is not utilized * * * to any appreciable extent, but remains unused in the tissues. Evidently, then, we should look to food rather than to medicines or mineral waters for the supply of iron needed in normal nutrition."

Egers has shown that the regeneration of the blood after a severe hemorrhage goes on much faster with a diet rich in food iron than when dependence is placed upon inorganic iron.

The Iron Content of Foodstuffs.

Foods differ greatly in their iron content, although the variation in the amount of iron present is less than is the case with lime. There are fewer foods which may be said to be very rich in iron than is the case in relation to the lime content, and perhaps fewer foodstuffs in which the deficiency is very marked.

Among the foods richest in iron are found some which we had not even suspected of being so rich in this essential metal food principle until this digest of technical data was made. Here are a few of the most important; the relative richness in iron being in the order as named:

Wheat bran, egg yolk, lentils, beans, peas, wheat, mustard greens, hazelnuts, barley, rye, beef, almonds, graham bread, spinach, turnip tops, and olives.

Each of the above named foodstuffs contain in one ounce more than 6 per cent. of the iron ration for one day, so that one pound of any of these foods, if eaten, would supply the necessary iron requirement.

In the case of several foods, the percentage of iron is so high that six to ten ounces is sufficient for a full day's ration. It is interesting to note that one vegetable product, the lentil, contains exactly the same percentage of iron as the yolk of egg and beans are not far behind, 6 ounces of lentils and 7½ ounces of beans supplying iron for one day. Peas, mustard greens and whole wheat supply iron for a day with less than three-quarters of a pound of their substance.

Of the foods which are poor in iron, thirty-three, or one-fourth of the total number, contain less than one per cent. of a day's ration. A large number (36 per cent.) contain between two and three per cent. of iron per ounce, making a total of 69 foodstuffs (51 per cent.) which may be classed as very low in iron. Such foods as cane sugar, confectionery, olive oil, lard and suet contain no iron at all.

It is evident that when these foods with low iron content are made use of, they should be supplemented by suitable foods rich in iron which are named in Table XII. (p. 170)

A study of the average iron content of the several classes of foodstuffs affords useful information.

When considered with reference to the amount of iron or the percentage of the day's iron ration contained in one ounce of material, we find the legumes, on the average, far ahead of all

others (11.35). Greens come next (6.14), then eggs (5.67). meats (4.29), cereals (3.9), nuts (3.49), fruits (1.74), vegetables (1.46), milk products (1.05), and milk (.47), with less than half of one per cent. of the daily requirement.

When examined with reference to the per cent. of the iron ration contained in 100 calories, the order of precedence is changed. First in the list is greens (46.4), then meats (15.6), legumes (13.7), vegetables (10.4), fruits (5.6), cereals (4.3), nuts (2.67), and lastly eggs (1.36).

Table XI shows all the essential facts in relation to the iron content of more than 100 common foods. The table presents seven columns, each of which deals with a special feature of the iron content. The several columns, numbered 1 to 7, present the following particulars:

1. The amount of food iron calculated as grains of metallic iron. in one ounce of foodstuff.
2. The per cent. of one day's iron ration (.213 grains) in one ounce.
3. The amount (ounces) of foodstuff required for one day's iron ration.
4. The per cent. of the iron ration found in 100 calories.
5. The weight in ounces of 100 calories.
6. The weight in ounces of an ordinary serving.
7. The number of calories in an ordinary serving.

By the use of this table it is possible very easily to determine the iron content of the food intake for a meal, a day, or any definite length of time.

TABLE XI.

The Iron Content of Foodstuffs.*

The following table shows in column (1) the amount of food iron calculated as grains of metallic iron in one ounce of foodstuff. (2) The percent of one day's iron ration (.213 grains) in one ounce. (3) The amount (ounces) of foodstuff required for one day's iron ration. (4) The percent of the iron ration found in 100 calories. (5) The weight in ounces of 100 calories. (6) The weight in ounces of an ordinary serving. (7) The number of calories in an ordinary serving.

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* Based upon the tables of Sherman in ("Chemistry of Food and Nutrition.") Macmillan Company.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Almonds	.0171	7.35	13.6	4.0	.5	.5	10
Apples	.0013	.56	177.7	3.2	5.6	5.0	100
Apples, dried	.0065	2.80	35.5	3.2	1.2	1.2	100
Apple juice	.0009	.39	256.6	3.0	6.0	6.0	100
Apricots	.0013	.56	177.7	3.5	6.1	3.0	50
Apricots, dried	.0061	2.64	38.0	3.5	1.1	.6	50
Asparagus	.0044	1.90	52.5	30.0	15.7	1.6	10
Bananas	.0026	1.12	90.0	4.0	3.5	3.5	100
Barley, entire	.0179	7.75	13.0	7.6	1.7		
Barley, pearled	.0088	3.80	26.2	3.8	1.0	3.5	100
Beans, dry	.0306	13.25	7.5	13.5	1.0	3.2	125
Beans, Lima, dry	.0306	13.25	7.5	13.3	1.0	2.25	25
Beans, Lima, fresh	.0088	3.80	26.0	10.7	2.9	4.0	25
Beans, soy	.0248	10.73	9.3	9.2	.86	.86	100
Beans, string, fresh	.0048	2.08	48.0	17.7	17.0	4.0	25
Beef, all lean	.0170	7.36	13.6	30.0	4.0	4.0	100
Beefsteak, med. fat	.0097	4.20	24.0	10.48	2.5	4.0	160
Beets	.0026	1.12	90.0	9.0	7.6	2.2	25
Blackberries	.0026	1.12	90.0	7.0	5.9	3.0	50
Bread, Boston Brown	.0131	5.6	17.5	9.0	1.2	1.2	100
Blood	.2301	100.0	1.0				
Blueberries	.0039	1.7	58.0	8.0	4.7	2.5	50
Bread, entire wheat	.0070	3.03	33.0	4.3	1.4	2.0	150
Bread, Graham	.0109	4.70	21.0	6.4	1.3	2.0	150
Bread, rye	.0070	3.03	33.0	2.6	1.4	2.0	150
Bread, entire rye (pumpernickel)	.0088	3.81	26.2	6.5	1.7	2.0	120
Bread, white	.0039	1.70	58.0	2.3	1.3	2.0	150
Brose	.0200	8.6	11.5	8.6	1.0	1.0	100
Brussels Sprouts	.0048	2.08	48.0	23.4	11.3	.3	25
Buckwheat flour	.0053	2.30	43.6	2.3	1.0	1.0	100
Butter	.0009	.40	256.6	.2	.46	.5	100
Buttermilk	.0011	.50	210.0	4.7	10.0	6.0	60
Cabbage	.0048	2.08	48.0	23.4	11.0	4.0	25
Cabbage greens	.0079	3.40	29.0	30.0	11.0	4.0	25
Cantaloup	.0013	.56	178.0	4.7	9.0	7.0	75
Carrots	.0026	1.12	90.0	9.0	7.3	3.7	50
Cauliflower	.0026	1.12	90.0	13.0	11.0	3.0	25
Celery	.0022	.95	105.0	18.0	18.0	1.0	5
Chard	.0100	4.70	21.0	44.0	8.7	3.0	35
Cheese	.0057	2.42	40.5	2.0	.77	.5	65
Cheese, cottage	.0042	1.82	55.0	5.8	3.2	2.0	60
Cheese, yogurt	.0043	1.84	51.0	1.7	.93	.5	50
Cherries	.0018	.78	128.0	3.4	4.7	2.55	50
Cherry juice	.0013	.56	177.7	2.5	4.6	5.0	100
Chestnuts	.0031	1.30	77.0	2.0	1.4	1.0	100
Chicken	See beef.						
Cocoanut. fresh	.0051	2.21	45.5	2.0	.9	1.0	110
Corn, whole	.0127	5.50	18.0	5.0	1.0		
Cornmeal	.0039	1.70	58.0	2.0	1.0	4.5	75
Corn, sweet, fresh	.0035	1.50	66.0	4.8	3.5	2.7	75
Corn, sweet, dried	.0127	5.50	18.0	5.5	1.0	1.0	100
Crackers	.0066	3.0	35.0	2.4	.9	1.0	110
Cranberries	.0026	1.12	90.0	9.0	7.5	3.0	40
Cream	.0010	.43	231.0	.7	1.8	2.2	125
Cucumbers	.0009	.40	255.6	8.0	20.0	2.0	10
Currants, fresh	.0022	.94	110.0	6.0	6.0	3.0	50
Currants, dried, Zante	.0109	4.72	21.0	6.0	1.1	1.5	135
Dandelion greens	.0118	5.11	19.4	30.0	5.5	3.0	50
Dates	.0131	5.67	17.5	6.0	1.0	1.0	100

Dock, narrow leaved	.0280	13.4	7.5				
Eggplant	.0022	.95	110.0	12.3	12.3	1.5	10
Eggs	.0131	5.67	17.5	13.6	2.4	1.8	75
Egg, one (1.8 oz.)	.0244	10.54				1.8	75
Eggwhite	.0004	.17	580.0	1.3	4.7	1.0	125
Eggwhite of 1 egg (1.2 oz)	.0005	.20				1.2	15
Eggyolk	.0376	16.32	6.0	15.3	.94	1.0	100
Eggyolk of 1 egg (.6 oz.)	.0226	9.8				.6	60
Endive	.0106	4.6	20.0	50.5	11.0	3.0	25
Farina	.0035	1.51	65.6	1.5	1.0	1.0	100
Figs, dried	.0131	5.67	17.5	6.3	1.1	2.0	180
Figs, fresh	.0044	1.47	52.5	6.3	3.4	2.0	60
Fish (haddock)	.0029	1.3	80.0	6.3	3.0	6.0	200
Flour, buckwheat	.0053	2.30	45.6	2.3	1.0		
Flour, entire wheat	.0110	4.72	21.0	4.7	1.0		
Flour, graham	.0162	7.0	15.5	7.0	1.0		
Flour, white	.0044	1.90	52.5	1.5	1.0		
Flour, rye	.0057	2.47	40.5	2.5	1.0		
Flour, rye entire	.0146	6.54	16.0	6.3	1.0		
Gluten, pure	.1487	64.30	1.5	64.3	1.0	.5	50
Gluten, 40%	.0600	26.00	3.8	26.0	1.0	1.0	100
Gluten, 20%	.0300	13.00	7.7	13.0	1.0	1.0	100
Gooseberries	.0022	.95	105.0	6.0	6.0	2.5	40
Grapefruit	.0013	.56	177.0	4.0	6.7	3.5	50
Grapes	.0013	.56	177.0	2.0	3.6	3.6	100
Grapejuice	.0013	.56	177.0	2.0	4.0	4.0	100
Hazelnuts	.0179	7.75	13.0	4.0	.5	.5	100
Hominy	.0040	1.69	58.0	1.7	1.0	1.0	100
Honey	.0031	1.34	77.0	2.0	1.1	1.6	150
Huckleberries	.0039	1.69	58.0	8.0	5.0	2.5	50
Kohl-rabi	.0026	1.12	90.0	9.0	8.0	4.0	35
Lemon juice	.0026	1.12	90.0	9.0	8.0		
Lentils, dried	.0377	16.32	6.1	19.5	1.1	3.0	100
Lettuce	.0031	1.34	74.5	52.3	18.4	1.0	5
Maple Syrup	.0121	.57	17.5	7.0	1.3	1.3	100
Malt Sugar	.0214	9.30	10.8	9.3	1.0	2.0	200
Malted Nuts	.0192	8.3	12.0	5.5	.7	1.3	200
Macaroni	.0053	.51	43.6	2.2	1.0	3.0	100
Meat (tenderloin)	.0131	6.00	17.6	7.0	1.2	2.4	200
Milk, whole	.0011	.47	210.0	2.3	5.1	6.0	120
Milk, buttermilk	.0011	.50	210.0	4.7	10.0	6.0	75
Milk, skimmed	.0011	.47	210.0	4.5	9.6	6.5	65
Milk, Condensed, sweetened	.0026	1.12	90.0	1.3	1.1	2.0	180
Milk, human	.0023		100.0	5.0		5.0	100
Molasses	.0320	1.38	7.3	17.0	1.2	1.2	100
Muskmelon	.0013	.56	175.0	5.3	8.8	7.0	75
Mustard greens	.0213	9.22	10.0			3.0	
Nuttolene	.0171	7.40	13.5	14.8	2.0	2.0	100
Oatmeal	.0166	7.19	14.0	6.4	.9	4.2	75
Olives	.0127	5.49	18.0	6.5	1.2	1.2	100
Onions	.0026	1.12	90.0	7.0	7.2	2.5	35
Oranges	.0009	1.69	256.6	2.6	6.8	5.0	75
Orange juice	.0009	1.69	256.6	3.0	8.0	6.0	75
Parsnips	.0026	1.12	90.0	6.0	5.4	3.0	55
Peaches	.0013	.56	180.0	5.0	8.0	4.0	50
Peaches, dried	.0052	2.29	45.0	5.0	4.0	2.0	50
Pears	.0013	.56	180.0	3.1	5.5	4.0	75
Peas, dry	.0249	10.78	9.2	11.0	1.0	3.0	100
Peas, green	.0074	3.16	31.0	11.3	3.5	3.5	100
Peanuts	.0088	3.81	26.2	2.4	.6	.6	100

Pecan nuts	.0114	4.93	20.3	2.3	.5	.5	100
Pineapple	.0022	.95	105.0	8.0	8.1	4.0	50
Plums	.0022	.95	105.0	4.0	4.1	4.0	100
Potatoes	.0057	2.47	40.5	10.4	4.2	3.0	75
Potatoes, sweet	.0022	.95	105.0	2.6	2.8	3.5	100
Protose	.0249	10.8	9.2	21.5	2.0	2.0	100
Prunes, dried	.0131	5.67	17.5	7.0	1.2	3.7	100
Purslane	.0080	3.90	25.6				
Pumpkin	.0035	1.51	66.0	8.7	13.6	3.5	25
Radishes	.0026	1.12	90.0	13.7	11.9	1.0	6
Raisins	.0092	4.00	25.0	9.2	1.0	1.0	100
Raspberries	.0026	1.12	90.0	6.0	5.3	4.0	75
Red Root	.0280	12.90	7.8				
Rice, polished	.0039	1.68	58.0	1.7	1.0	4.0	125
Rice, brown	.0088	3.81	26.0	4.0	1.0	1.0	100
Romaine	.0525	22.75	4.4			3.0	
Rye flour	.0057	2.47	40.5	2.5	1.0	1.0	100
Rye, entire	.0171	7.40	13.4	9.6	1.3	1.3	100
Spinach	.0158	6.84	14.5	100.4	15.0	3.0	20
Spinach, mountain	.008	3.90	25.6				
Spinach, New Zealand	.009	4.10	24.4				
Squash	.0026	1.12	30.0	.9	7.6	3.7	50
Strawberries	.0035	1.51	66.0	13.7	9.4	4.0	45
Tapioca	.0070	3.03	33.0	3.0	1.0	1.0	100
Tomatoes	.0018	.78	128.0	11.7	13.3	4.0	25
Turnips	.0022	.95	105.0	8.5	9.0	4.5	50
Turnip tops	.0152	6.58	14.0			3.0	
Walnuts	.0092	4.00	25.0	2.0	.5	.5	100
Watercress	.0083	3.60	28.0			1.5	10
Watermelon	.0013	.56	177.7	6.6	11.6	8.0	75
Wheat, entire	.0219	9.50	10.55	9.0	1.0	5.7	150
Wheat bran	.0341	14.76	6.7	17.7	1.2	.5	43

To Determine the Iron Content of a Ration or a Dietary by the Use of the Table.

This determination may be made in several ways as follows:

1. The exact weight of the several articles which make up the ration or the bill of fare must be first ascertained. Then from the alphabetical table find in column 2 the figures representing the percentage of the iron ration found in one ounce. Multiply each of these per cents. by the weight in ounces eaten of the article. Add the results together and the sum will be the percentage of the iron ration found in the total food intake for the day. If the amount is 100, it exactly equals the normal requirement. If it is less than 100, there is a deficiency of iron, the amount of which is shown by the difference between the figures found and 100. If the figures are in excess of 100 the food intake comprises an excess of food iron. This is not a matter of consequence, however, as any excess will be carried off through the intestines, the principal channel through which waste iron is normally excreted. If a deficiency is found, it should be cor-

rected at once by the addition of some article rich in food iron, or by the substitution of some foodstuff poor in iron by another which is rich in this element.

2. A determination can be equally well made by the use of columns 4 and 7. If the foods are served in 100 calory portions as at the Battle Creek Sanitarium, this can be done very quickly. It is only necessary to find in the table the several articles eaten and set down the figures found in column 4, which represent for each article the per cent. of the day's ration found in 100 calories. In case a serving consists of more or less than 100 calories the figures found in column 4 must be increased or diminished accordingly.

The figures in columns 5 and 6 will sometimes be found of assistance in making the determinations by either of the above methods.

The figures given in column 3 are useful in showing at a glance the great difference in the iron content of different foodstuffs.

It is important to note that in the case of foodstuffs of which a very large quantity must be taken to supply a day's iron ration, the nature of the food is usually such that a large quantity may be taken without inconvenience so that, while the amount of iron per ounce may be small, it may be possible to take without inconvenience a sufficiently large quantity to more than balance the deficiency. This is particularly true in the case of fruit juices and greens.

To facilitate the work of balancing the bill of fare for the iron content the writer has, at the cost of a great deal of painstaking labor, for which a vacation afforded an opportunity, prepared the accompanying tables.

Foods Rich in Iron.

The accompanying table of foods rich in iron (Table XII). comprises less than one-third of the foods included in Table XI. Each foodstuff in this list supplies in one ounce at least four per cent., of one day's iron ration.

Some of these foods, particularly those which are found in the first half of the list, should enter liberally into each day's bill of fare. Without the free use of such foods, it is impossible to maintain the iron content of the body intact; the blood will deteriorate and all the bodily forces will languish. This is a matter to which every housewife, every individual, should give earnest attention. At a recent (1920) Race Betterment Exhibit in connection with a great Health and Sanitation Exhibition in Chicago, the writer had blood examinations for hemoglobin made in the cases of several thousand persons. The average was found to be 80, or 20 per cent. below the normal. There can be no doubt that practically the whole American population is anemic because of the lack of iron-containing foodstuffs in the national bill of fare. The average American bill of fare offers almost no iron-rich food except meat. The consumption of meat is steadily decreasing because of high prices and the spreading of information respecting the advantages of a non-flesh dietary. The effect of discarding meats must be to increase the national anemia unless other more natural sources of iron are added to the bill of fare. Fortunately, the place of meat as a source of food iron may be easily filled, as reference to Table XII will show. Instead of standing at the head of the list of iron-rich foods, steak is forty-ninth in the list. More than a dozen vegetable foods contain double the amount of food iron supplied by meat; half a dozen, three times as much; four, more than four times as much; and two, more than ten times as much. Even such common garden weeds as red root and dock, contain twice as much iron as does an equal weight of meat and better iron, while bran, molasses, lentils and egg yolk contain about three times as much.

Evidently the old notion that one must eat red meat to enrich the blood is an error; it is in the green things that the richest stores of food iron are to be found.

TABLE XII.

Foods Rich in Iron.

	(a)	(b)
Savora (Yeast extract)	.626	.37
Gluten, pure	.149	1.5
Gluten 40%	.060	3.8
Romaine	.052	4.0
Egg yolk	.038	6.0
Lentils, dried	.038	6.1
Wheat bran	.034	6.7
Molasses	.032	7.3
Beans, Lima	.031	7.5
Dock greens	.028	7.5
Red root greens	.028	7.8
Beans, soy	.025	9.3
Peas, dry	.025	9.2
Protose	.025	9.2
Egg (one)	.024	(9.5)
Egg yolk (one)	.023	(10.2)
Wheat entire	.022	10.5
Malt sugar	.021	10.8
Mustard greens	.021	10.0
Brose (oatmeal, cornmeal, bran)	.020	11.5
Malted nuts	.019	12.0
Hazelnuts	.018	13.0
Almonds	.017	13.6
Beef, lean	.017	13.6
Nuttolene	.017	13.5
Oatmeal	.017	14.0
Rye, entire	.017	13.4

	(a)	(b)
Flour, graham	.016	15.5
Spinach	.016	14.6
Flour, entire rye	.015	16.0
Turnip tops	.015	14.0
Boston brown bread	.013	17.5
Corn, whole	.013	18.0
Corn sweet, dried	.013	18.0
Dates	.013	17.5
Eggs	.013	17.5
Figs, dried	.013	17.5
Meat, tenderloin	.013	17.6
Olives	.013	18.0
Prunes	.013	17.5
Dandelion greens	.012	19.4
Maple syrup	.012	17.5
Pecans	.011	20.3
Endive	.011	20.0
Chard	.010	21.0
Graham bread	.011	21.0
Zante currants	.011	21.0
Whole wheat flour	.011	21.0
Beef, medium fat	.010	24.0
Raisins	.009	25.0
Walnuts	.009	25.0
Brown rice	.009	26.0

(a) Grains of iron (Fe) in one ounce.

(b) Amount (ounces) of the substance required to supply a day's ration of iron.

THE LIME RATION.

Taken by itself, in its mineral form, lime possesses no food value, or at least only under exceptional circumstances, as when the body is deprived wholly of lime from other sources. Even then, mineral lime can be utilized only in very small quantities. It was, indeed, long a mooted question among physiologists whether inorganic lime ever could be utilized by the animal organism. In recent years carefully conducted experiments by Mendel and Osborne, as well as other investigators, have shown that when an animal is fed with food from which lime has been excluded, the deficiency may be made up by feeding inorganic lime; but it is evident that this use of mineral lime is exceptional and the biologic law that vegetables feed upon mineral substances and animals upon organic matters built up by vegetable organisms working under the influence of the sun's rays, still holds good.

Recent experimental studies in the feeding of animals have placed in a very clear light the importance of lime as a constituent of the food. The facts recently emphasized, while not altogether new, have caused the importance of giving constant and special attention to the lime content of foodstuffs to be more fully appreciated than ever before.

The great importance of lime is suggested by the fact that this one element constitutes fully three-fourths of the total mineral content of the human body. The body of a man weighing 154 pounds contains about 4½ pounds of lime, or 3% of the body weight.

Nearly all the lime of the body (99%) is found in the bones, the soft parts containing less than 1 per cent. of the total lime content of the tissues. Hence the deficiency of lime in meats.

The Daily Loss of Lime.

An adult of average weight loses two-thirds of a gram or about ten grains of lime, daily, the waste lime being excreted chiefly through the intestine, but also to some extent through the kidneys. This loss of lime is constant, even during fasting. It is evident, then, that in order that the store of lime in the body should be kept intact, the daily food supply must contain not less than ten grains of lime. In fact, to provide for emergencies and the failure of the absorbents to take up all the lime contained in the food it is found to be necessary to supply in the food about fifty per cent. more than the actual requirements, or fifteen grains of lime daily. Some authorities demand more than this.

Unfortunately, the food commonly eaten by no means always contains this amount. Indeed, Dr. Sherman of Columbia University calculates that at least half the people of the United States are suffering from lime starvation. Probably lime is more often deficient in the dietary of the average American than any other element with the exception of iron and cellulose.

The fact that lime is found in every bodily tissue, bones, soft tissues, blood and other fluids, indicates its universal importance in the body.

1. To the bones it gives solidity. The bones of the adult are more than half lime. The amount of lime in the bones is so great that a burned bone retains its form even though the animal part has been wholly destroyed by fire. A deficiency of food lime causes in young children bow-legs and is no doubt one of the causes of decay of the teeth.

2. The ability of the muscles to contract and to do work depends not alone upon their development and to the presence of fuel sugar in the blood and glycogen in the muscles, but also upon just the right proportion of lime in the blood. When lime is deficient, the muscles lose their tone and become flabby and weak.

3. The blood contains a very small proportion of lime, only about .8 grains to the pint (cow's milk contains fifteen times as much), but this small amount is absolutely essential to maintain the normal beating of the heart through its influence upon the

heart muscle. The mammal heart has been kept beating for hours after removal from the body by passing through it a solution of lime and other salts.

4. Again, it is known that the presence of this minute amount of lime in the blood is essential to enable the blood to coagulate or clot to stop the flow of blood from a wounded vessel. A careful surgeon always examines the patient's blood and determines the coagulation time before undertaking a serious operation. When coagulation is delayed, a transfusion of a pint or more of healthy blood may be given before the operation is performed.

The relation of lime to the development of the bones is well shown by an experiment upon puppies. Those fed on lean meat and fat only, had soft and flexible bones. Puppies to which bones were given, gnawed at the bones and thus obtained the necessary lime and developed normally.

Voit, an eminent physiologist who devoted his life to the study of food problems, fed pigeons for a year on foodstuffs which were greatly deficient in lime. There seemed to be no change in the birds which appeared to be in perfect health, but after they were killed, careful examination showed that while the leg and wing bones contained the normal amount of lime, the bones of the head were almost wholly deprived of lime, being greatly thinned, and at some points actually perforated. Evidently the body had sought to maintain the normal blood content of lime by robbing those parts of the skeleton from which it could best be spared.

Sherman, of Columbia, repeated Voit's experiment, employing monkeys instead of pigeons. The results were the same. The leg and arm bones did not suffer much, but the skull bones lost their lime almost altogether, becoming so thin that they could be crushed between the thumb and fingers as easily as an eggshell.

Some years ago the authorities in charge of the London Zoo observed that the lion cubs were deformed, bowlegged, clubfooted, dwarfed and always died young. Treves, an eminent London surgeon, was consulted. He asked about the food. He was informed that they were given the very best of meats. He suggested the feeding of bones and bone meal. His advice being followed, the deformities soon disappeared, and the cubs ceased to die prematurely.

The cave dwellers, who in prehistoric times were compelled by the rigors of the ice age to subsist on a flesh diet, rounded out their diet by splitting bones and eating portions of them, especially the marrow.

According to Cobez de Baca, one of the Spanish explorers of the Texas Coast in the sixteenth century, the natives of that region carefully saved the bones of fishes and other small animals and ate them after reducing them to powder in stone mortars.

The lack of lime in the food is no doubt one cause of the increasing prevalence of bone disease in civilized countries, and may be responsible for the early decay of the teeth which is becoming so nearly universal that the development of a toothless race is threatened. Evidently the teeth suffer loss of lime along with the other bony structures of the head.

Hart and Steenback showed that milch cows require food containing a large amount of lime. If such food is not supplied their bones are robbed of lime. Nature takes care to see that milk, the sole food of the very young animal, contains an adequate amount of lime, even at the expense of the mother.

This interesting observation explains the negative results of a very plausible theory advanced many years ago as the basis for a plan for securing painless childbirth. Expectant mothers were told to avoid milk, grains, and lime containing vegetables, and to make their diet consist chiefly of fruits and nuts which are very poor in lime. The idea was that in so doing the bones of the infant would contain less lime and the infant head, the chief cause of suffering, would thus be less rigid and would easily mould itself to the outlet of the pelvis. Hundreds tried the food formula for "painless" childbirth, but the results were most disappointing. Experiments upon animals showed that no matter how much the lime in the mother's food was reduced, the bones of the offspring always contained the normal amount. The mother's bones were robbed to make good the deficiency of lime in the food.

Here also is found perhaps an explanation of the remarkable tendency to decay of the teeth which often appears in the last months of pregnancy, a fact long known but not explained. Recent studies conducted by members of the faculty of the dental department of the University of Michigan show that the saliva becomes very deficient in lime during the last months of gestation.

Infants and young children require two or three times as much lime in proportion to their weight as do adults, since they need lime for building up and solidifying the skeleton as well as for making good the daily waste. A young nursing infant gets daily in its mother's milk more than three grains of lime, or one-fifth as much as the daily requirement for an adult weighing ten to fifteen times as much.

The wonderful care which Nature takes to supply the young animal with an abundance of lime for building its skeleton is well illustrated in the interesting case of the egg. According to the *Annals of the Pasteur Institute,* before incubating, the contents of an egg contain one-half grain of lime. During incubation, the amount steadily increases until when hatched the body of the chick contains three grains, or six times as much lime as at first. The growing chick has in some mysterious way, not yet determined, managed to steal from the shell the needed lime for stiffening its slender leg bones so as to enable them to support its body as soon as it emerges from its calcareous cell. It thus appears that the egg shell is not simply a container but also serves as a store house of lime to be drawn upon by the developing chick.

Herbst has shown that between the ages of 6 to 14 boys require three or four times as much lime in proportion to their weight as do adults, since they must store up in their growing bones, 3 to 6 grains of lime daily, or about one-third of the adult maintenance lime ration.

The Influence of Lime on Egg Production.

Buckner and Martin (*Journal Biologic Chemistry*) have shown that when fowls are abundantly supplied with food containing lime, the egg production may be increased as much as 70 per cent. This experiment clearly shows the influence of diet upon nutrition. Children whose diet does not comprise a sufficient amount of food lime, grow slowly because of the lack of lime for bone building and the bones are likely to be poorly developed. On this account housewives should take great care to see that the family diet contains an abundance of greens, such as spinach, dandelion, dock, lamb's quarter, chard, and other green vegetables.

The Lime Content of Foods.

The proportion of lime found in different foodstuffs varies greatly. This fact is of much importance in view of the recent observations of Osborne and Mendel as well as of other investigators who have undertaken exhaustive experiments in animal feeding, and have shown that rats do not grow, develop and reproduce normally unless supplied with a full quota of lime.

If the assertion of Professor Sherman that "half the American people are suffering from lime starvation" is true, and there is no reason to doubt it, the study of foods with reference to their lime content is highly essential to our understanding of rational dietetics. This study has heretofore been greatly neglected.

First of all it is interesting to note that in general, roots and the green parts of plants (greens) are richest in lime. The legumes (beans, peas and lentils) and certain nuts (almonds, hazelnuts and walnuts) are also rich in lime. Of the grains, oatmeal is the only one which presents a fair proportion of lime. Wheat and corn are both very deficient in lime, and rice contains almost no lime at all.

Of all natural food products, the richest in lime are the hazelnut, the almond and linseed meal. The last named product, though not commonly used as a food may be resorted to in emergency and is doubtless entirely wholesome.

Milk is so rich in lime that a pint and a quarter contains sufficient of this necessary element for a full day's supply. But an equal amount of lime would be furnished by half the weight of almonds, and eight or nine ounces of hazelnuts will supply the same quantity, or six ounces of linseed meal.

The foods which contain the largest proportion of lime and in the order named are,—cheese, cottage cheese, hazelnuts, almonds, molasses, beans, chard, and other greens, egg yolk, wheat bran, milk, skimmed milk, olives. In milk the lime is closely associated with the casein which forms the curd. Milk contains more lime than is found in lime water.

In cheese the lime is of course concentrated, the proportion being about six times as great as in milk.

Since skimmed milk contains practically as much lime as does whole milk, it is a highly useful article of food. Not a drop should be wasted. By combining with other foodstuffs as in bread and other cereal preparations, with the addition of fat, it may be very advantageously made a regular part of the daily bill of fare.

The feeding of skimmed milk to pigs is a foolish waste. Our growing boys and girls need every drop of milk which the country produces.

We are losing our teeth and shrinking in stature because we need more lime and milk is one of our most important sources of food lime.

The amount of lime required by the average adult is three-fourths of a grain for each 100 calories of food or about 15 grains a day for a person taking a ration of 2,000 calories. This amounts to 4/5 of a pound per annum for each man, woman and child in the United States aggregating a total lime requirement for the country of 40,000 tons per annum.

That the nation fails to get its full lime ration is due in part to the wasting of milk in our dairy industry and in part to the fact that we unwisely deprive ourselves of an essential food element by feeding the bran of our wheat and other foodstuffs rich in lime to hogs and cattle instead of making use of them ourselves. As a natural result, our domestic animals are steadily improving in physical development while as a nation we are declining in vigor and showing distinct indications of physical degeneracy.

It is interesting to note that our wide awake agricultural department at Washington is advising the people to buy milk instead of meat, pointing out that its nutritive value is far greater. Even whey contains a notable amount of lime, more than a third as much as whole milk, but less than a twentieth as much as cheese. However, the amount is so large that it should be utilized when possible. When fresh, or only slightly acid, whey is a wholesome food having about one-third the value of whole milk.

Wheat bran contains as much lime as does milk, but of course it cannot be taken in so great quantities as milk, hence is less available as a source of lime.

It is interesting to note that molasses contains a good proportion of lime, more than three times as much as is found in oatmeal, and nearly twice as much as in milk. In this respect molasses is superior to sugar, which contains no lime at all. In molasses, the lime found in the natural juices of the cane is concentrated; it is probable that the lime used in the manufacture of sugar may be the source of part of the lime in molasses. Maple syrup contains half as much lime as does molasses.

A careful study of Tables XIII and XIV will develop a considerable fund of most useful information. The method of using Table XIII in balancing the bill of fare for lime is the same as that used in balancing for iron as already explained. (See p. 165).

Foods Deficient in Lime.

It is very instructive to note the great number of common foods which in the form in which they appear upon our tables are almost wholly lacking in lime. The table shows, in fact, more than fifty common foods which are so poor in lime that one would need to eat not less than six pounds to obtain an adequate amount of lime for a single day. In some instances the lime content is so small that the amount of foodstuff necessary to furnish a day's ration rises to ten, twenty, and even forty pounds.

Among the foods most deficient in lime may be mentioned the following: cane sugar, which contains no lime; honey, which supplies in one pound of wax-free material, only one-fortieth of the lime needed for one day. Apples, bananas, beef and other meats, butter, also lard and oils of all sorts, most of the cereals and nearly all fruits are deficient in lime.

An examination of the average bill of fare will show it to be woefully deficient in food lime as well as in iron, and, naturally, in other salts as well. To assist in remedying this deficiency, we have prepared the accompanying list of foods which are rich in food lime. Foods selected from this list, especially the first third of it, should be made a part of every day's bill of fare, and in liberal quantities. The number of foods rich in lime is so great, it is easy to provide for abundant variety while insuring an abundance of food lime. Three tumblerfuls of milk (20 ounces), four ounces of cottage cheese, five of mustard or red root greens, or half a pound of hazelnuts or filberts will supply a full day's lime ration. Half a pound of soy beans, lamb's quarters or turnip greens will do the same. It is better, however, to secure the needed lime with a greater variety of foods which may easily be chosen from Table XIV.

TABLE XIII.

The Lime Content of Foodstuffs.*

The following table shows in column (1) the amount of lime (grains) contained in one ounce. Column (2) shows the percent of one day's lime ration in one ounce. Column (3) shows the amount of the foodstuff required to supply 15.4 grains of lime (CaO) the amount required for one day. Column (4) shows the percent of one day's requirement of lime found in 100 calories. Column (5) shows the weight of an ordinary serving. Column (7) gives the number of calories in an ordinary serving.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Almonds	1.464	9.5	10.5	5.2	.5	.5	100
Apples	.043	.3	358.0	1.6	5.3	5.3	100
Apples, dried	.196	1.3	78.5	1.6	1.2	1.2	100
Apple juice	.049	.5	314.3	1.6	6.0	6.0	100
Apricots	.086	.6	180.0	3.3	6.1	3.0	50
Apricots, dry	.404	2.6	38.0	3.3	1.1		
Asparagus	.153	1.0	100.6	17.1	15.7	1.7	10
Bananas	.055	.4	280.0	1.2	3.5	3.5	100
Barley, entire	.263	1.7	58.5	3.0	1.7		
Barley, pearled	.122	.8	126.2	1.1	1.0	(3.5)	100
Beans, dried	.980	6.4	15.7	6.5	1.0	(3.2)	125
Beans, lima, dry	.435	2.8	35.4	2.8	1.0	(2.3)	100
Beans, lima, fresh	.171	1.1	90.0	2.8	2.9	3.0	100
Beans, soy	2.000	13.0	7.7	11.2	.86	.86	100
Beans, string, fresh	.282	1.8	54.6	13.0	17.0	4.0	25
Beef, tenderloin	.057	.4	270.0	.45	1.29	2.5	200
Beets	.178	1.2	86.5	8.9	7.6	(2.2)	25
Blackberries	.104	.7	150.0	4.2	5.9	3.0	50
Blueberries	.122	.8	126.2	3.8	4.7	2.2	50
Bran	.735	4.8	21.0	5.7	1.2	.5	43
Bran, Wheat	.735	4.8	21.0	5.7	1.2	.5	43
Bread, Boston Brown	.790	5.1	19.5	7.9	1.2	1.2	100
Bread, entire wheat	.133	.9	116.0	1.23	11.44	2.0	150
Bread, Graham	.176	1.2	90.0	1.60	1.34	2.0	150
Bread, rye	.147	1.0	105.0	1.3	1.4	2.0	150
Bread, entire rye (Pumpernickel)	.259	1.7	60.0	2.8	1.7	2.0	120
Bread, white	.091	.6	170.0	.8	1.3	2.0	150
Bread, fruit	.514	3.3	30.0				
Brose (Oatmeal and Bran)	.485	3.1	32.0	3.0	1.0	1.0	100
Brussels Sprouts	.165	1.1	93.3	12.1	11.3	4.0	
Buckwheat flour	.239	1.6	64.4	5.9	1.0		
Butter	.092	.6	167.4	.3	.6	.5	113
Buttermilk	.643	4.2	24.0	41.1	10.0	6.1	75
Buttermilk Yogurt	.747	4.8	20.6	46.3	9.6	6.5	75
Cabbage	.276	1.8	56.0	20.0	11.1	4.0	25
Cabbage greens	.649	4.2	23.7	47.3	11.0	4.0	25
Cantaloup	.104	.7	150.0	6.1	9.0	7.0	75
Carrots	.343	2.2	44.9	33.3	7.3	3.7	50
Cauliflower	.753	4.9	20.4	56.4	11.0	3.0	25

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* This table is chiefly based upon the extended tables by Sherman, "Chemistry of Food and Nutrition," Macmillan Company.

Celery	.478	3.1	32.2	58.9	18.0	1.0	6
Chard	.919	6.0	16.7	55.0	8.7	3.0	35
Cheese	5.702	37.0	2.7	29.7	.77	.5	70
Cheese, cottage	4.180	27.1	3.7	35.2	3.2	2.0	75
Cheese, Yogurt	4.285	27.8	3.6	26.0	.93	.5	50
Cherries	.116	.8	133.0	3.5	4.7	2.2	50
Cherry juice	.104	.7	150.0	3.1	4.6	4.6	100
Chestnuts	.208	1.3	75.0	1.9	1.4	1.5	100
Chicken, broiler	.066	.43	235.0	1.4	3.25	2.5	75
Coconut, dry	.361	2.3	42.6	.9	.6		
Coconut, fresh	.147	1.0	105.0	.9	.9	2.0	225
Corn, whole	.122	.8	126.2	.8	1.0	1.0	100
Cornmeal	.110	.7	140.0	.7	1.0	(4.5)	75
Corn, sweet, fresh	.037	.2	416.0	.8	3.5	(2.7)	75
Corn, sweet, dry	.129	.8	114.4	.8	1.0		
Cow Peas	.612	4.0	25.1	4.1	1.0		
Cottonseed meal	1.623	10.5	9.5	9.2	.9		
Crackers	.135	.9	114.0	.8	.9	1.0	110
Cranberries	.110	.7	140.0	4.4	7.5	3.0	40
Cream	.527	3.42	29.2	7.2	1.75	2.2	125
Cucumbers	.098	.6	157.0	12.6	20.0	2.0	10
Currants, fresh	.159	1.0	96.8	6.3	6.1	3.0	50
Currants, dry, Zante	.502	3.3	30.7	3.6		1.5	140
Dandelion greens	.643	4.2	24.0	24.1	5.5	3.0	
Dates	.398	2.6	38.6	2.6	1.0	1.0	100
Dock (narrow leaved)	1.000	6.7	15.0				
Egg Plant	.067	.4	230.0	5.7	12.2	1.5	10
Eggs	.450	2.9	34.2	6.3	2.4	1.9	80
Egg, one (1.8 oz.)	.810	5.2	19.0			1.08	80
Egg white	.092	.6	167.4	2.8	4.7	1.0	14
Egg white of one (1.2 oz.	.116	.7	140.0			1.2	17
Egg yolk	.839	5.4	18.3	5.0	.9	1.9	100
Egg yolk one (.6 oz.)	.503	3.3	30.6			.6	60
Endive	.637	4.1	24.0	45.5	11.0	(3.0)	25
Farina	.129	.8	119.4	.8	1.0		
Figs, dry	.992	6.4	15.6	7.2	1.1	2.0	180
Figs, fresh	.325	2.1	47.4	7.2	3.4	2.0	70
Fish	.134	8.7	114.6	2.6	3.0	6.0	200
Flour, buckwheat	.061	.5	252.5	1.5	1.0		
Flour, entire wheat	.190	1.2	81.0	1.2	1.0		
Flour, graham	.239	1.6	64.4	1.5	1.0		
Flour, white	.122	.8	136.2	.8	1.0		
Flour, rye	.110	.7	140.0	.7	1.0		
Flour, rye entire	.293	1.9	52.5	2.5	1.3		
Gluten Pure	1.025	6.6	15.0	6.6	1.0	.5	50
Gluten 40%	.400	2.6	38.0	2.6	1.0	1.0	100
Gluten 20%	.200	1.3	76.0	1.3	1.0	1.0	100
Gooseberries	.214	1.4	72.0			2.5	
Grapefruit	.129	.8	119.4	5.6	6.7	3.5	50
Grapes	.115	.7	133.0	2.7	3.6	3.5	100
Grapejuice	.067	.4	230.0	1.5	4.0	4.0	100
Guava	.086	.6	180.0				
Hazelnuts (filberts)	1.758	11.4	8.8	5.7	.5	.5	100
Hominy	.067	.4	230.0	.2	1.1	1.6	150
Honey	.024	.2	268.6	.2	.1	1.6	150
Kohl-rabi	.472	.3	32.6	34.9	11.5	(4.0)	35
Lamb's Quarters	1.900	12.5	8.0				
Lemon juice	.147	1.0	105.0	8.4	8.9	.5	5
Lentils, dry	.655	4.3	23.5	4.3	1.1	(3.0)	100
Lettuce	.263	1.7	58.5	31.4	18.4	1.0	5
Linseed meal	2.530	16.4	6.1				

Malt Sugar (Meltose)	.262	1.7	60.0	1.7	1.0	2.0	200
Maple Syrup	.655	4.3	23.5	5.3	1.3	1.2	100
Malted Nuts	.433	2.3	35.5	1.9	.7	1.3	200
Macaroni	.135	.9	114.0	.8	1.0	(3.0)	100
Mango	.129	.8					
Meltose	.122	.8	126.2	1.5	1.2	2.4	200
Milk, whole	.735	4.8	21.0	24.3	5.1	6.0	125
Milk, skimmed	.747	4.8	20.6	46.3	9.6	6.5	75
Milk, condensed (sweetened)	1.837	11.9	8.4	15.3	1.1	2.0	180
Milk, human	.208	1.4	70.0	7.0	4.75	5.0	100
Milk, camel's	.876	5.7	17.5				
Milk, goat's	.784	5.1	20.0				
Milk, sheep's	1.266	8.2	12.2				
Molasses	1.292	8.4	12.0	10.2	1.1	1.2	100
Mushrooms	.104	.7	150.0				
Millet	.086	.5	180.0				
Muskmelon	.104	.7	150.0	6.0	8.8	7.0	75
Mustard greens	3.013	19.6	5.1			3.0	
Nuttolene	.263	1.7	58.5	3.4	2.0	2.0	100
Oatmeal	.423	2.7	36.4	2.4	.9	(4.2)	75
Okra	.435	2.8	35.4	2.4	9.3	(4.5)	50
Olives	.747	4.9	20.6	5.7	1.2	1.2	100
Onions	.208	1.3	75.0	9.7	7.2	(2.5)	35
Oranges	.276	1.8	55.7	12.3	6.8	5.0	75
Orange Juice	.178	1.2	86.5	9.3	8.0	6.0	75
Paprika	1.401	9.1	11.0				
Parsnips	.361	2.3	42.7	12.8	5.4	(3.0)	55
Peaches	.098	.6	157.1	5.3	8.1	4.1	50
Peaches, dry	.208	1.4	75.0	5.3	4.0	2.0	50
Pears	.092	.6	167.4	3.3	5.5	4.0	75
Pear juice	.055	.4	280.0	1.4	3.9	6.0	150
Peas, dry	.514	3.3	30.0	3.6	1.0	(3.0)	100
Peas, green	.171	1.1	90.0	4.0	3.5	3.5	100
Peanuts	.435	2.8	35.4	1.8	.6	.6	100
Pecan nuts	.545	3.5	28.2	1.7	.5	.5	100
Persimmons	.135	.9	114.0				
Pineapple	.110	.7	140.0	5.8	8.1	4.0	50
Plums	.122	.8	126.2	3.3	4.1	4.1	100
Potatoes	.086	.5	180.0	2.5	4.2	(3.0)	75
Potatoes, sweet	.116	.7	133.0	2.3	2.8	(3.5)	200
Protose	.416	2.7	37.0	5.4	2.0	2.0	100
Prunes, dried	.331	2.2	46.5	2.5	1.2	(3.7)	100
Pumpkin	.141	.9	109.2	12.5	13.6	(3.5)	25
Purslane	.880	5.8	17.2				
Quinoa	.900	4.7					
Radishes	.129	.8	119.4	10.2	11.9	1.0	6
Raisins	.392	2.5	39.3	2.8	1.0	1.0	100
Raspberries	.300	2.0	52.3	10.4	5.3	4.1	75
Raspberry juice	.129	.8	119.4	3.0	3.4	5.0	150
Red Root	3.240	21.6	4.6				
Rice, polished	.055	.3	280.0	.3	1.0	(4.0)	125
Rice, brown	.073	.5	211.0			3.0	
Romaine	.276	1.8	57.0				
Rutabagas	.453	2.9	24.0	25.9	8.8	(4.0)	25
Rye, entire	.337	2.2	45.7	3.0	1.3		
Spinach (mountain)	1.270	8.5	11.8				
Spinach	.410	2.7	37.0	39.3	15.0	(3.0)	20
Spinach New Zealand	.480	3.2	31.0				
Squash	.116	.7	133.0	5.5	7.6	(3.7)	50
Savora	1.207						

Strawberries	.251	1.6	61.3	14.6	9.4	4.7	50
Tapioca	.141	.9	109.2	.6	1.0	1.0	100
Tomatoes	.067	.4	230.0	7.0	15.3	4.0	25
Tomato juice	.037	.2	416.0				
Turnips	.392	2.5	39.3	22.6	9.0	(4.5)	50
Turnip tops	2.125	13.8	7.2			3.0	
Walnuts	.545	3.5	28.3	1.8	.5	.5	100
Watercress	1.153	7.5	13.4	135.0	18.0	1.5	10
Watermelon	.067	.4	230.0	5.3	11.6	8.0	75
Wheat, entire	.276	1.8	56.0	1.8	1.0	(5.7)	150
Wheat, bran	.735	4.8	21.0	5.7	1.2	.5	48
Wheat, germ	.435	2.8	35.4	2.8	1.0	1.0	100
Whey	.269	1.9	57.2	22.7	13.0	7.0	50

TABLE XIV.

Foods Rich in Lime.

	(a)	(b)
Cheese	5.70	2.7
Yogurt Cheese	4.28	3.6
Cottage Cheese	4.18	3.7
Red Root	3.24	4.6
Mustard Greens	3.01	5.1
Linseed Meal	2.53	6.1
Turnip Tops	2.13	7.2
Soy Beans	2.00	7.7
Lamb's Quarters	1.90	8.0
Condensed Milk	1.84	8.4
Hazelnuts	1.76	8.8
Cottonseed Meal	1.62	9.5
Almonds	1.46	10.5
Molasses	1.30	1.20
Milk, Sheep's	1.27	12.2
Mountain Spinach	1.27	11.8
Savora	1.21	
Watercress	1.15	13.4
Pure Gluten	1.03	15.0
Dock Greens	1.00	15.0
Figs, Dry	.99	15.6
Beans	.98	15.7
Chard	.92	16.7
Milk, Camel's	.88	17.5
Purslane	.88	17.2
Egg Yolk	.84	18.3
Egg, One	.81	(19)
Boston Brown Bread	.79	19.5
Milk, Goat's	.78	20.0
Sour Milk	.75	20.6
Cauliflower	.75	20.4
Milk, Skimmed	.75	24
Olives	.75	20.6
Bran, Wheat	.74	21.0
Milk, Whole	.74	21.0
Lentils, Dry	.66	23.5
Maple Syrup	.66	23.5
Cabbage Greens	.65	23.7
Buttermilk	.64	24.0
Dandelion Greens	.64	24.0
Endive	.64	24.0
Cow Peas	.61	25.1
New Zealand Spinach	.48	31.0
Wheat Germ	.44	35.4
Spinach	.41	37.0

(a) Grains in one ounce.

(b) Ounces required for one day's ration (15.4 grains).

The following foods rich in both lime and iron should be made conspicuous features of the daily bills of fare; by their liberal use, any serious deficiency in food lime or iron may be very certainly avoided (Table XV) :—

TABLE XV.

Foods Rich in Both Lime and Iron.

- Almonds
- Boston Brown Bread
- Bran
- Chard
- Dandelion-greens
- Dock-greens
- Egg Yolk
- Endive
- Figs, Dry
- Gluten, Pure
- Hazelnuts
- Lentils
- Maple Syrup
- Molasses
- Mustard Greens
- Olives
- Red Root
- Savita
- Spinach
- Turnip Tops

ACIDS AND BASES OF FOODS—THE REACTION BALANCE.

As pointed out by Bunge many years ago, and as further shown by an extensive research conducted by Sherman, of Columbia University, foodstuffs differ in relation to their acid and basic contents. In certain foods, bases or alkalies predominate, while in others the mineral acids predominate.

The waste products of the body are predominantly acid, consequently it is desirable that the foodstuffs should be predominantly basic. If acids predominate in the ration, and this condition continues for a considerable period of time, the effect will be to disturb the nice balance between acids and bases, which is normally maintained in the body fluids and which is essential for life. The predominance of acids gives rise to a condition known as acidosis (p. 719), and care must be taken to protect the body from injuries which result from this condition. It is important that the food should be so selected that there will always be a decided predominance of such foods as will tend to alkalize the body fluids.

All lean meats are acid. Besides other acids, they contain a considerable amount of uric acid. Classified according to the predominance of acids or bases, the several sorts of foods may be grouped as follows:

Meats of all sorts, especially the lean meats, tend to acidify the tissue fluids to a marked degree. Eggs tend in the same direction, though less strongly than do meats. Meat extracts, broths, bouillon, meat stocks and gravies, all belong in the group of acidifying foods.

Cereals of all sorts, including breads of every description, contain a preponderance of acids, though much less than that of meats.

A few fruits, particularly cranberries, plums and prunes, must also be placed in this class because of the presence of benzoic acid, which is not oxidized in the body.

All other fruits, green vegetables and root vegetables of all sorts, are strongly basic and tend to alkalinize the tissue fluids.

Milk is slightly alkaline.

The following table shows in a condensed form the principal facts which have been ascertained by modern chemical researches respecting the acid and basic properties of foodstuffs, acid foods being those which tend to acidify the tissue fluids and basic or alkaline foods those which tend to alkalinize the fluids:—

TABLE XVI.

	Acid	Basic (Alkaline)
Lean beef	10.0*	
Eggs	9.0	
Round steak	6.7	
Oatmeal	3.2	
Wheat	2.6	
Wheat Flour	2.7	
Rice	2.4	
Bacon	1.0	
Celery		40
Cabbage		10—13.6
Potatoes		9—12
Turnips		6.6—12.5
Apples		5
Milk		3.3
Beans		2.9—6.8
Peas		1.9

---

*The figures indicate the equivalent number of cubic centimeters of normal acid or alkaline solution per 100 calories.

Vitamins

These subtle elements, which have been in recent years proven to be absolutely essential to life and health, are present in food in such small quantities that notwithstanding the prodigious amount of work which has been bestowed upon them, their chemical composition is not yet known. The proof of the existence of this class of food principles and their importance to human life rests upon numerous observations which have shown that in their absence various disorders known as deficiency diseases make their appearance.

Vitamin appears to be an essential constituent of nerve tissue. Funk found vitamin in ox brain and other investigators have found vitamin in the spinal cord.

When vitamins are not present in the food in sufficient amount, the vitamin constituent of the nerves is gradually lost and degeneration of the nerve tissue with paralysis follows as the result. Several weeks and even months may be required for the consumption of the store of vitamins in the nerve tissues of the body, but a study of animals subjected to a dietary deficient in vitamins has shown that degenerative changes in the nervous system begin early, as may be demonstrated by microscopic examination.

Vitamins are necessary to promote growth. In their absence young animals do not develop, reproduction does not take place, mothers are not able to nurse their young, appetite and nutrition and various diseases develop, among the best known of which are scurvy, beri-beri, rickets, perhaps pellagra, and certain diseases of the eye.

Even malignant growths are influenced by the lack of vitamins. Short asserts that cancer of rats has been shown to grow only one-fourth as rapidly when vitamins are absent.

Ehrlich in experiments upon rats demonstrated that by means of an exclusive diet of rice, cancer could be made to cease growth and sometimes to nearly disappear. He remarked to the writer, who visited his laboratory when the experiments were in progress, that it was "necessary to starve the rats nearly to death." Evidently they were suffering from lack of vitamins, particularly the water-soluble vitamin *A*.

The existence of at least three well defined vitamins has been clearly proven. Deficiency of the *antiscorbutic* or water-soluble C vitamin, causes scurvy. Deficiency of the *antineuritic,* or water soluble B. vitamin, gives rise to beri beri. The absence of a third vitamin, designated as fat soluble A, gives rise to certain forms of eye disease and probably also to rickets besides dwarfing the growth of young animals.

Vitamins are produced only by vegetables. In order to insure a full supply of all the different vitamins it is important that the dietary should be varied. Infants and invalids are the most likely to suffer from lack of vitamins because they are often fed for long periods upon the same food in which there is very little variety.

McCarrison has shown that when the water-soluble B vitamin, which is supplied by the bran of cereals, greens and root vegetables, is lacking, the resistance of the body to the invasion of the tissues by bacteria is greatly lowered.

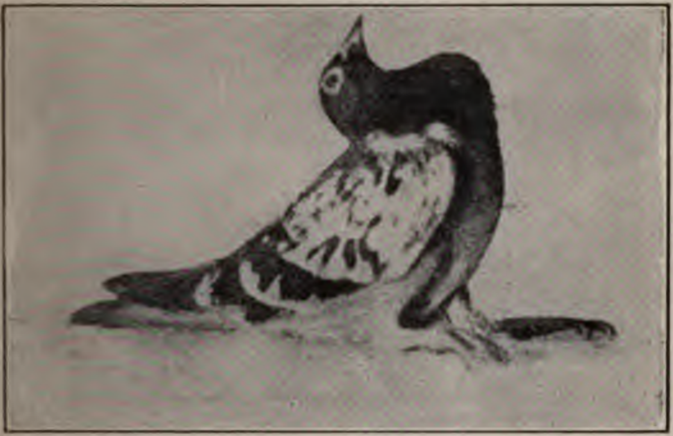
The Antiscorbutic Vitamin.

The antiscorbutic vitamin is found in the juices of fresh fruit and vegetables, and particularly in the orange, the lemon, and the grapefruit. Recent observations have shown that the antiscorbutic vitamin is also found in abundance in the potato and the turnip, and to some extent in the tamarind. It is probable that all green vegetables are more or less antiscorbutic.

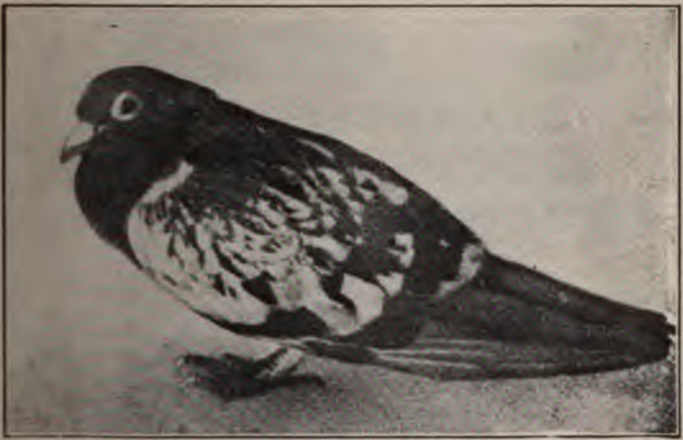
The antiscorbutic vitamin is readily destroyed by boiling and also by drying. It is absent in salted meats. The process of sterilizing milk destroys the antiscorbutic vitamin and pasteurizing injures it. On this account raw or uncooked vegetables or fruits should make up a part of each day's bill of fare.

It has been found that orange juice may be dried at a low temperature without losing its antiscorbutic properties, especially if air is excluded. This will probably be found to be true of other fruits or fruit juices and green vegetables.

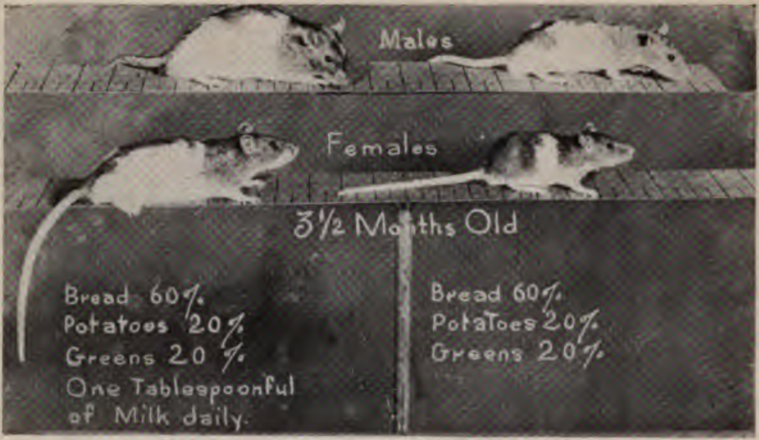
Recent experiments on guinea pigs reported by Zilva and Wells indicate that one of the first effects of scurvy, an effect which seems to have been long overlooked, because not easily recognizable, is to be found in the teeth. There was found even in very slight cases, complete fibrosis of the pulp. It is probable that decay of the teeth is really due in many cases to scurvy, the presence of which was overlooked.



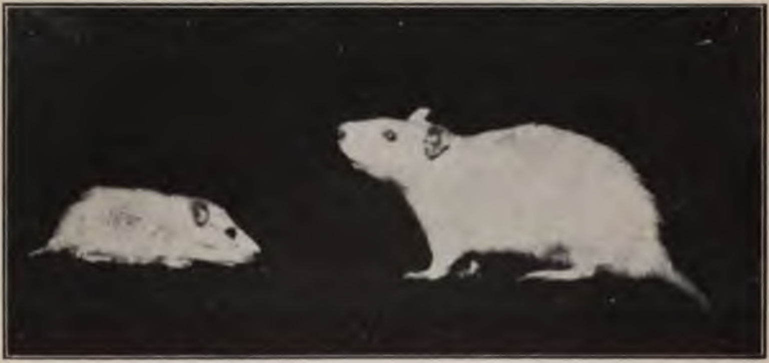
A Bird Nearly Dead from Lack of Vitamins



The Same Bird a Few Hours after the Injection
of the Needed Vitamins (Funk).



Experiments showing Deficiency of Lime and Vitamins
(*Nutrition Laboratory of the Battle Creek Sanitarium*).



Rats of the same age (12 weeks). The smaller (A) was fed bread and apple, all it would eat, (B) was given bread and milk and weighed five times as much as A. (*Sherman*).

Dr. Wood of the Forsythe Dental Clinic of Boston maintains that deficiency of vitamins is the probable cause of pyorrhea as well as of other dental disorders.

The Chinese have long made use of sprouted seeds in the form of salad and combined with vegetables in various ways. Sprouted soy beans is one of the constituents of the famous chop suey. Recently Chick and Delf, of London, have made a study of the comparative value of dry and sprouted peas and lentils in preventing scurvy. They found that these seeds when soaked twenty-four hours in water and then sprouted forty-eight hours at room temperature, were five or six times as active as dry seeds in preventing scurvy, and in this respect compared well with many fresh vegetables. So small a quantity as one and one-fourth grams (one-third dram) of the sprouted seeds fed daily was found sufficient to prevent scurvy in guinea pigs. This amount is somewhat greater than the amount of raw turnips or cabbage, fresh orange juice or lemon juice required, but is less than the amount of raw carrot or beet root needed.

An outbreak of scurvy among Serbian soldiers during the World War was successfully treated by the use of sprouted beans.

The antiscorbutic power of germinated seeds is considerably lessened by boiling.

Holst tells us that Cartier, on his last voyage to Newfoundland in 1535, cured his crew of 103 men, who with the exception of three were sick with scurvy, by administering to them a freshly prepared decoction of pine needles.

The writer is acquainted with a case in which a prospector saved himself from scurvy by eating grass when all of the members of his party suffered seriously.

A very good salad may be prepared from sprouted soy bean seeds which have been allowed to grow to the length of about an inch. Sprouted soy bean seeds also add an excellent quality to vegetable soups. The property which these seeds have of producing highly valuable vitamins makes very desirable the encouragement, in this country, of the use of sprouted seeds.

Barley, wheat, lentils, peas and beans are best suited for this purpose. Puncture a dozen holes in the bottom of a tin pan. Fill the pan half full with the beans(soy, or better, Mung beans). Fill the pan with water, cover closely and set in a warm place where the water may drain away. Refill the pan with water three times a day so as to keep the beans moist. Allow sprouts to grow until an inch or two in length. The beans should be thoroughly washed before putting to soak, to prevent molding.

Sprouted beans are one of the chief ingredients of the famous chop suey of the Chinese restaurants, and may account for the popularity of this dish. Sprouted beans, eaten as a salad, supply all three of the vitamins, a fact well worth knowing.

Fresh fruits are rich in the scurvy-preventing vitamin, at least this is true of citric fruits; but recent observations by Osborne and Mendel have shown that fruits in general do not contain a large amount of the water-soluble growth-promoting vitamin which is found in abundance in the branny coat of cereals, in root vegetables and greens.

The Anti-neuritic or Anti-beri-beri Vitamin.

The antineuritic vitamin, the absence of which produces beri-beri, is found in most vegetables and vegetable juices. In cereals it is almost wholly confined to the outer covering or bran and the germ. Fine wheat flour, polished rice and new process corn meal, contain this vitamin only in infinitesimal amounts and are equally lacking in other vitamins.

The continuous exclusive use of these foodstuffs causes beri-beri, a most distressing malady which may easily prove fatal and which, until recent years, caused the death of many thousands of persons annually in the Philippine Islands from the use of polished rice.

Emmett and Luros, from studies of the effect of heat on brown rice and vitamin B preparations from yeast and milk, conclude there are two vitamins which have heretofore been classed together as water-soluble B.

Beri-beri is a disease by no means confined to the Philippines, China and Japan, where it has long been known. During the war, beri-beri developed rapidly in the British army, in the Dardanelles and in Mesopotamia, when the soldiers were fed for a time almost exclusively on a diet consisting of wheat, canned meats and jam. Canned foods with the exception of tomatoes contain little or no vitamins. White bread is almost wholly devoid of vitamins, and jam contains none.

Thousands of persons, men, women and children in civilized life are exposed to all the dangers of a deficient diet. These dangers may be eliminated by taking care to make free use of fresh, uncooked foods daily. Graham bread should be used instead of fine flour bread and so-called whole wheat bread. Oatmeal is a better breakfast food than rice, cornmeal, corn flakes and other cereals from which the bran has been removed. In experiments upon pigeons, it has been shown that bread made from graham flour supplies all the elements necessary for the prevention of beri-beri, whereas beri-beri quickly develops on a diet of fine flour bread.

Spinach, even dried spinach, is an excellent source of vitamins. Dried spinach contains twice as much of the vitamins as do whole wheat, soy beans, dried eggs or milk powder. It is far superior to cabbage, lettuce and celery.

Dr. Ishiguro, the eminent Japanese military surgeon, who had great opportunities for observation during the Russo-Japanese war, denied that the lack of meat was the cause of beri-beri in the Japanese army, and called attention to the fact that the increased consumption of meat in Japan has been accompanied by an increase in the prevalence of beri-beri.

Cooper has shown that the amount of antineuritic vitamin required depends to some extent upon the amount of carbohydrate eaten. In the feeding of pigeons, if the amount of starch in the food is increased, the amount of vitamins must also be increased. It is important to bear this fact in mind in the management of bottle-fed infants.

In general, the juices of raw fruits and vegetables are much richer in growth-promoting vitamins than is milk. Osborne and Mendel have noted that the tomato contains a rich supply of all the vitamins.

Yeast Extract Very Rich in Vitamins.

Yeast is extraordinarily rich in the water-soluble vitamin which encourages growth and prevents beri-beri. Yeast, both fresh and dry, has for many years been used as a remedy. It has been especially popular for boils. Careful scientific investigation has shown that whatever merit yeast possesses is not due to the activity of living yeast cells, since yeast which has been sterilized by heat, is equally as efficacious as the fresh growing yeast.

Whatever therapeutic value yeast may have doubtless depends upon the water-soluble vitamins and salts which it contains. Dry yeast is rich in the growth-producing vitamin (water-soluble B) and contains 5-11 per cent. of organic salts with 50-60 per cent of proteins.

Yeast extract was much used in the world war, especially in Mesopotamia, as a means of combating beri-beri among the British troops. It is now available in this country. (Savita, Marmite, Vegex), and is much more efficient than yeast, besides having an agreeable mushroom flavor.

The Fat-soluble Vitamin.

The chief sources of the highly important fat-soluble vitamin are milk, butter and other dairy products, and the green leaf. Greens of many sorts are largely used by the Chinese and other Orientals who make little use of milk. Greens should be much more largely used in this country not only for their precious vitamins but also for the food lime and iron which they supply.

The fat-soluble vitamin is not found in lean meat, but is present in the liver, kidneys and other glands of animals in which certain quantities are stored as a measure of safety.

The Eskimo finds it necessary to eat the raw, frozen liver of the seal to prevent the disastrous consequences which follow the deficiency of vitamins in his ordinary diet.

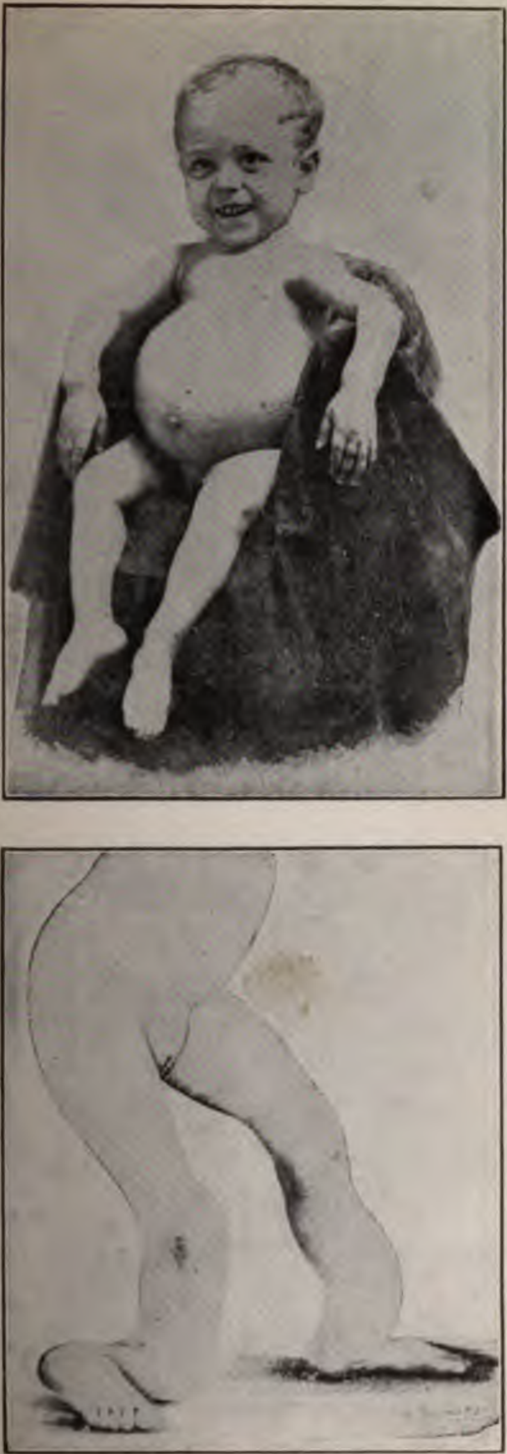
Another delicacy which is greatly enjoyed by dwellers in the Arctic regions is the intestine of the ptarmigan, a bird which lives upon the green leaves of the willow or heather, which are very rich in vitamins. When a bird is killed, the Eskimo opens its abdomen and scoops out its long, squirming intestine, and swallows it warm and quivering, as an Englishman or an American *gourmet* swallows a raw oyster, thus making available for his own use the vitamins found in the half-digested greenstuffs with which the intestine is filled.

When a young Lapp goes out to hunt reindeer, his best girl charges him to bring her a stomach. These Northern people eat with great avidity the half-digested reindeer moss which they find in the reindeer's stomach.

The absence of the fat-soluble vitamin gives rise to sore eyes in rats, the eyes being finally destroyed with ulceration of the cornea if the lacking element is not supplied. Night blindness has also been attributed to this cause.

Recent experience has shown that the fat-soluble A prevents rickets as well as sore eyes.

The observations of Mellanby show that the fat-soluble A



Changes Due to Rickets—Deficiency of Fat-Soluble A.
(Holt)

vitamin is found in olive oil, cottonseed oil and cocoanut oil, although absent in linseed oil. It is less abundant in these vegetable oils, however, than in butter.

The fat-soluble vitamin is of especial importance to growing animals. The water-soluble appears from experiments by Mendel and others to be more important for adults.

Both the water-soluble and the fat-soluble vitamins are closely associated with growth.

The fat-soluble vitamin is fifteen times as soluble in fat as in water. It is found in young shoots, in the yolks of eggs, and in yellow corn and carrots as well as in milk, cheese and butter. It is apparently associated with the yellow color known as "carotin."

Skim milk contains only half as much of the fat-soluble vitamin as does full milk for the reason that half of the vitamin content of the milk is removed in the cream. The fat-soluble vitamin is also found, though not very abundantly, in the soy bean and the peanut. The most important source of this highly important element is the green leaf.

The observations of Osborne and Mendel have demonstrated that dried alfalfa contains twice as much of the fat-soluble vitamin as a quantity of milk containing the same amount of solids. Dried alfalfa, clover, grass, spinach and carrot were found to be equal to butter fat as sources of the fat-soluble vitamin. The same was found to be true of the dried tomato.

With these important facts in mind it is evident that there need never be a shortage of the necessary vitamins provided only that proper care is exercised in the selection of foodstuffs, since these essential elements are found in abundance in the simplest and cheapest of food materials.

The following tables show the relative amounts of the several vitamins found in various common foodstuffs:—

TABLE XVII.

Anti-neuritic or Beri-Beri Preventing Vitamins.

Foods Rich in	*Foods Poor in*
Brewer's yeast	Sterilized milk
Egg yolk	Sterilized meat
Ox heart	Cabbage
Milk	Turnips
Beef and other fresh meat	Carrots and other vegetables of this type
Fish	Highly milled cereals
Beans	Starch
Peas	Pork
Oats	Molasses
Barley	Corn sirup
Wheat	Corn starch
Corn and other cereals	

TABLE XVIII.

Anti-Scorbutic Vitamins.

Foods Rich in	*Foods Poor in*
Fresh vegetables	Dried vegetables
Fresh fruits	Dried fruits
Raw milk	Sterilized milk
Raw meat	Canned meat
Cereals sprouting	Dried cereals
Tomatoes	Pork fat, Starch
Turnip juice	Molasses, Corn sirup

TABLE XIX.

Fat-soluble Growth-Promoting Vitamins.

Foods Rich in

Butter	Carrots, fresh or dried
Cream	Yellow corn
Egg yolk	Millet
Milk	Soy bean, sprouted
Greens	Wheat germ
Celery	Barley, sprouted
Lettuce	Beans, sprouted
Spinach, dried	Tomatoes, dried

A British committee appointed by the English Medical Research Committee to study the subject of food relief in famine districts, published the following table, which will be found useful in the selection of footstuffs with reference to their vitamin content:—

TABLE XX.

Showing the Vitamin Content of Common Foodstuffs.

	Fat-soluble A or antirachitic factor	Water-soluble B or antiberi-beri factor	Anti-scorbutic factor
Fats and oils:			
Butter	+++	0	
Cream	++	0	
Cod-liver oil	+++	0	
Beef fat or suet	++		
Peanut oil	+		
Lard	0		
Olive oil	0(+)		
Cotton-seed oil	0(+)		
Coconut oil	0(+)		
Cocoa butter	0		
Linseed oil	0		
Fish oil, whale oil, herring oil, etc.	++		
Hardened fats, animal or vegetable origin	0		
Margarine prepared from animal fat	Very slight		
Margarine from vegetable fats or lard	0		
Nut butters	+		
Meat, fish, etc.:			
Lean meat (beef, mutton, etc.)	+	+	+
Liver	++	++	+
Kidneys	++	+	
Heart	++	+	
Brain	+	++	
Sweetbreads	+	++	
Fish, white	0	Very slight, if any	
Fish fat (salmon, herring, etc.)	++	Very slight, if any	
Fish roe	+	++	
Tinned meats		Very slight	0
Milk, cheese, etc.:			
Milk, cow's, whole, raw	++	+	+
Milk, cow's, skim, raw	0	+	+
Milk, cow's, dried whole	less than++	+	less than+
Milk, cow's, boiled whole	Undetermined	+	less than+
Milk, condensed, sweetened	+	+	
Cheese, whole milk	+		
Cheese, skim	0		
Eggs:			
Fresh	++	+++	?0
Dried	++	+++	?0
Cereals, pulses, etc.:			
Wheat, maize, rice, whole grain	+	+	0
Wheat, maize, germ	++	+++	0

Wheat, maize, bran	0	++	0
White wheaten flour, pure cornflour, polished rice, etc.	0	0	0
Custard powder, egg substitutes, prepared from cereal products	0	0	0
Linseed, millet	++	++	0
Dried peas, lentils, etc.	—	++	0
Peaflour (kilned)	—	0	0
Soy beans, haricot beans	+	++	0
Germinated pulses or cereals	+	++	++
Vegetables and fruits:			
Cabbage, fresh	++	+	+++
Cabbage, fresh, cooked	—	+	+
Cabbage, dried	+	+	V. slight
Cabbage, canned	—	—	V. slight
Swede, raw expressed juice	—	—	+++
Lettuce	++	+	++
Spinach, (dried)	++	+	
Carrots, fresh raw	+	+	+
Carrots, dried	Very slight		
Beetroot, raw, expressed juice	—	—	less than +
Potatoes, raw	+	+	+
Potatoes, cooked	—	—	
Lemon juice, fresh	—	—	+++
Lemon juice, preserved	—	—	++
Lime juice, fresh	—	—	V. slight
Lime juice, preserved	—	—	+++
Orange juice, fresh	—	—	++
Raspberries	—	—	
Apples	—	—	
Bananas	+	+	V. slight
Tomatoes (canned)	—	—	
Nuts	+	++	
Yeast, dried	—	+++	
Yeast extract (Savita, Marmite)			
Meat extract	0	0	0
Malt extract	—		
Beer	—	0	0

How Vitamins are Destroyed.

Vitamins are destroyed by the action of heat or alkalies and are removed by the so-called "high milling" of cereals.

The antiscorbutic vitamins are destroyed by boiling and are damaged by a temperature of 160 degrees F., the usual temperature employed in pasteurizing milk.

A boiling temperature impairs, but does not destroy the fat-soluble and antineuritic vitamins.

Canned meats and other foods are often heated to a temperature of 240° F. for two or three hours. This is necessary to destroy the spores of putrefactive germs which are not killed by ordinary cooking temperatures. It is evident that canned foods must be deficient in vitamins.

Funk found that a dog fed exclusively on canned beef died in two weeks.

Canned foods should never constitute a large part of the dietary. Fresh foods, rich in vitamins, are needed daily to maintain the nerve tissues in health and to prevent scurvy and other deficiency diseases.

The fat-soluble vitamin is apparently not affected by the temperatures ordinarily employed in cooking. Mendel found the fat-soluble vitamin of butter fat to be uninjured by exposure to a temperature of 230° for sixteen hours.

Vitamins are destroyed by alkalies. For this reason, the use of carbonate of soda in cooking is to be strongly condemned. When bicarbonate of soda is used in the making of bread, it is by the process of baking converted into carbonate of soda, which is strongly alkaline and destroys vitamins. The old-fashioned method of making biscuit by the use of soda and sour milk is likewise objectionable.

Baking powder biscuit, as ordinarily made, have an alkaline reaction which affords sufficient evidence that the vitamins are damaged or destroyed.

Pellagra prevails most extensively in certain districts in the South where the new process cornmeal is generally used. This preparation of corn is almost wholly deprived of vitamins by the process of milling, and when prepared with baking soda what small proportion of vitamins remains may be destroyed.

In mountainous regions contiguous to the localities where pellagra is very prevalent, the disease is either absent or only rarely encountered. These mountaineers are so far away from the cities where new process cornmeal is obtainable that they are obliged to have their corn ground in the small mills scattered through the mountains, in which the old-fashioned stone burrs are still in use. The cornmeal made in this way represents the entire grain and is comparatively rich in vitamin.

Holt and others have called attention to the fact that an increase of carbohydrates in the diet of a child necessitates a liberal increase in the vitamin content of the dietary. If this is neglected, nutrition and development fail. For this reason, the amount of orange juice or tomato juice must always be increased when a child is placed upon a cereal diet or when there is an increase in the malt sugar added to the milk. No doubt this principle applies with equal force in the feeding of adults, so that the free use of cane sugar at meals, or in the form of confectionery at any time, must involve vitamin deficiency since cane sugar contains no vitamins while at the same time producing a special demand for an increase of this essential food constituent. No doubt the free use of cane sugar is in this way responsible for many thousands of cases of nutritive disorders of various sorts occurring especially in this country in which the use of cane sugar is carried to a very great excess.

This is a matter to which every person who has charge of dietetaries should give attention. A person may easily starve to death in the midst of plenty and while eating abundantly, for lack of the precious vitamins found in spinach and other fresh foods. Every meal should include a liberal supply of spinach or other greens. An abundant supply of greens should be provided for the table during the winter as well as the summer months.

The effect of cooking upon the vitamins is highly important and should be given due consideration. During the war, scurvy broke out in a number of camps, affecting as many as 40 per cent of the men. It was found that the vegetables were cooked for three hours. When the cooking time was reduced to forty minutes, scurvy rapidly disappeared.

It was also noticed that in camps located near apple orchards, from which apples were obtained and freely eaten, no scurvy occurred. Lime juice is found to have little value in preventing scurvy, but lemon and orange juice are highly valuable, and tomato juice, even the juice of canned tomatoes, is nearly as good. The juice of turnips and a drink prepared from tamarinds has also proved to be valuable, as well as soup prepared from potatoes.

It has been noticed that scurvy frequently occurs among the inmates of institutions when potatoes are scarce and high in price. Raw cabbage is better than orange juice in preventing scurvy, but cooked cabbage is much less valuable.

Recent studies (1921) at the University of Wisconsin by Steenbock and others seem to show that the fermentation which takes place in sauerkraut and silage, destroys the antiscorbutic vitamin.

Experiments reported by the United States Public Health Service showed that in fowls fed on fine flour bread, neuritis appeared at the end of twenty to thirty days.

Fowls fed on whole wheat remained in good health.

Fowls fed on corn grits or new process cornmeal showed neuritis in three to seven weeks.

Fowls fed on old-fashioned water-ground cornmeal or the whole corn remained well.

The Unique Value of the Tomato.

According to Mendel and Osborne, the tomato is unique as a source of vitamins, being rich in all three of the known vitamins, fat-soluble A and water-Soluble B and C. This is true not only of the fresh tomato but of both canned and dried tomatoes. This fact places the tomato at the head of our common foods as a means of insuring to the body an adequate supply of all the vitamins. It should be used very freely.

Hess tells us that the juice or purée of canned tomatoes may be regarded as a palatable solution of the three vitamins and a serviceable antiscorbutic for artificially fed infants. It may be used in doses of one ounce daily.

Cellulose

Cellulose is found exclusively in vegetable products. It forms the framework and fibers of plants, the walls of vegetable cells and the coverings of seeds. Wood consists of cellulose with the addition of layers of cork.

The chemical composition of cellulose is identical with that of starch and dextrin from which, in fact, it is often formed in the chemistry of the plant.

In its ordinary form, cellulose is insoluble in boiling water, and is not acted upon by the digestive fluids of the alimentary canal, although it is digested by the ferments of certain bacteria which sometimes flourish in great numbers in the colon.

Special forms of cellulose are soluble in boiling water. On cooling this dissolved cellulose forms a gelatinous mass. Agar is a cellulose of this sort. It is found in seaweeds which grow along the coast of Japan. In commerce, it is sometimes known as Japanese isinglass, or Ceylon moss.

The cellulose in fresh fruits and vegetables and in tender shoots is softened and broken up in cooking, and to a large extent disappears through the action of bacteria in the colon.

Bran.—The outer coverings of seeds consist of cellulose combined with layers of cork cells, a woody substance much more resistant than the cellulose found in green vegetables. Bran is for this reason an excellent form of roughage. It is needed on every table and at every meal as an accessory food to make good the deficiencies of the ordinary bill of fare in cellulose as well as iron, lime, and vitamins.

The cellulose of bran, of seeds, of berries, the coarser fibers of vegetables and agar, escapes the action of bacteria in the colon and hence is of great value in giving to the intestinal contents the bulk necessary to stimulate peristaltic activity.

The composition of bran varies greatly according to the amount of fine middlings included with it. The best bran consists of large flakes of nearly uniform size and free from middlings.

When well softened with water, bran is not irritating, but is an emollient. The thin films of cellulose become as soft and pliable as wet paper, and excite the bowel, not by scratching or irritating it, but by a gentle titillation, so to speak, and by giving to the food sufficient mass to distend the intestine and stimulate it to vigorous activity. This was observed by Cannon in his X-ray studies of digestion in cats.

In its ordinary commercial form, bran is seldon fit for use, on account of the large amount of dirt which it contains, including insects and bacteria. For use as a food laxative, it should be carefully prepared by thorough cleaning and washing of the wheat before grinding and sterilization of the bran. Sterilized bran, first introduced by the writer many years ago, is now prepared by various manufacturers and is put up in convenient packages. One or two rounded tablespoonfuls should be taken at each meal, the amount depending upon the character of the other foods taken. The writer has never seen any ill effects from the use of sterilized bran which he has prescribed for many years, although there are many cases in which it fails to produce the desired effect and has to be supplemented by the use of paraffin oil as a lubricant.

This is particularly true in cases in which the cecum is greatly dilated or crippled by adhesions from chronic appendicitis and in cases in which there is obstruction of other parts of the colon, especially the pelvic colon as the result of adhesions.

The combination of paraffin oil with bran or agar-agar in some form is also useful in cases of spastic contraction due to colitis.

Experience shows that from half an ounce to an ounce of cellulose must be taken with the meals daily, to insure sufficient bulk to stimulate the intestine to action. In cases in which the colon is very redundant or is crippled by adhesions, even double this amount may sometimes be needed, at least until the bowel has been trained to normal action. This amount of cellulose is provided by two rounded tablespoonfuls of sterilized bran in addition to other laxative foods.

The amount of food required to furnish two-thirds of an ounce (300 grains) of cellulose may be ascertained by reference to the accompanying tables. (Tables XXI— XXIII).

In the tables of cellulose, the term *cellulose* is made to include the cork and other indigestible vegetable matters associated with it. It will readily be seen that bran or agar is almost absolutely essential as an addition to ordinary foodstuffs to provide the bulk required for efficient bowel action.

It will be noted that foodstuffs differ greatly in their cellulose content, seedy fruits, greens and legumes, supplying this element in larger relative amount than any other food.

TABLE XXI.

Showing the Cellulose in Cereals.

	Number of Cellulose grains in one ounce	Grains of Cellulose in 100 Calories	Ounces necessary to give 300 grains of Cellulose
Wheat (cooked)	10	38	30
Wheat Grits (cooked)	5	27	60
Rolled Wheat (cracked)	9	36	30
Graham Flour	10	9.6	30
Fine Flour	1.5	1.4	200
Oatmeal (cooked)	44	37	6
Barley (cooked)	20	64	15
Polished Rice	2	1.96	150
Unpolished Rice	3.75	3.68	82
Rye (small)	15	14.4	20
Corn Meal	10	9.7	30
Corn Flakes	10	9.7	30
Beans (dried)	40	40	75
Peas (dried)	20.5	28.5	10
Lentils	20	19.6	15
Granola (cooked)	10	9.8	30
Sterilized Bran	200	--	1.5
Graham Bread	6	8	50
Whole Wheat Bread	5	7	60

TABLE XXII.

Showing the Cellulose in Vegetables.

	Number of Cellulose grains in one ounce	Grains of Cellulose in 100 Calories	Ounces necessary to give 300 grains Cellulose
Asparagus	5.2	37.4	57.7
Beans	4.0	12.9	75

Beets	5.25	45	57
Brussels Sprouts	7.85	131	40
Cabbage	9.2	145	32.4
Carrot (raw)	4.9	36	60
Cauliflower (steamed)	4.55	44.6	66
Celery (raw)	7.0	127	45
Cucumber (raw)	3.9	78	75
Green Peas	9.35	27	32.2
Kohl-rabi (raw)	7.75	86	39
Lettuce	3.65	65	82
Onion	3.55	33.7	85
Parsnips	8.65	50	36
Peas (dried)	28.5	27	10.8
Potato (baked)	5.45	16.6	55
Pumpkin	6.1	65.6	50
Spinach	4.65	50	65
Tomatoes	4.20	63.6	71
Turnip	6.6	100.8	46

TABLE XXIII.

Showing the Cellulose in Fruits.

	Number of Cellulose grains in one ounce	Grains of Cellulose in 100 Calories	Ounces necessary to give 300 grains of Cellulose
Prunes (cooked)	10	36	30
Apples	5	5	60
Pears	15	81	20
Peaches	5	40	60
Plums	7.5	30	40
Cherries	10	44	30
Raspberries, red	37	200	81
Blackberries	25	150	12
Huckleberries	61	300	5
Strawberries	10	87	30
Currants	23	138	17
Grapes	7.5	36	40
Raisins	7.5	38.4	30
Raisins (stewed)	7.4	--	40
Oranges	10	67	30
Bananas	1.5	5.2	200
Figs	22.5	24.3	13.3
Apricots	12.5	74	24
Gooseberries (stewed)	17.5	90	17
Cranberries	25	51	12

It should further be mentioned that in the use of cellulose in concentrated form as in sterilized bran, the whole amount used at a meal should not be taken at once, as at the beginning or end of a meal, but should be well mixed with the food by taking small portions at frequent intervals during the meal.

It should also be mentioned that for greatest efficiency as a laxative, bran should be used in liberal quantities at every meal.

There has been much discussion about the digestibility of bran and the advisability of its use. Naturally its digestibility is less than that of fine flour. Its value depends upon its indigestibility. But it does not interfere with the digestibility of other foodstuffs to any appreciable extent. Mendel and Osborne have shown by feeding experiments, using white rats, that bran may be made to take the place of meat as a source for protein; and Hindhede, food controller of Denmark during the world war, claims to have demonstrated the same. During the war the Danish people lived almost exclusively on barley porridge, vegetables, greens, milk and bread. In making their bread they added wheat bran to their coarse rye meal, and thrived upon it, reducing the annual death rate 34 per cent. No one starved, and no one was made ill by the coarse fare.

It is well known that the digestive organs of herbivorous animals are able to digest cellulose, a function which seems to have been lost by civilized human beings, for it has been shown (Tibbles) that the capacious cecum of the negro of the Nile and the Bushman secretes a ferment which dissolves the cellulose covering of vegetable cells It is claimed, also, that the vermiform appendix of the negro produces a ferment which digests cellulose.

But the digestibility of cellulose is of much less consequence than its indigestibility since its chief value in human food is to serve as roughage. The importance of cellulose as a food constituent is well known to farmers and to all feeders of animals. Rabbits, when fed on a diet containing no cellulose, rapidly die. When cellulose is not present in their food the movements of the intestine cease, inflammation follows and death soon after.

Experiments by Hart, as well as by Osborne and Mendel, have shown the cause of leg weakness in chickens to be lack of roughage. The difficulty disappeared when paper was given as roughage, but no improvement was noted by other changes in the diet which would have corrected any defect which might have arisen from lack of vitamins or salts in the food. These experiments clearly demonstrate the value of bran and other forms of roughage and should be of service to housewives and others who are responsible for the feeding of children, as well as to poultry raisers.

A study of the nutritive value of wood by Haberland showed that wood contains, especially in winter, considerable quantities of sugar, starch and oil, with small quantities of protein. These nutrient materials are found only in the living wood; that is, in the twigs, small branches and sap wood, not in the heart wood of the tree. Hard wood contains a considerable amount of starch, from one-fifth to one-fourth of its weight, while the pine, birch and linden contain considerable oil but little starch. The pine and spruce contain so much resin that they are quite unfit for food, and the oak and the willow are objectionable on account of the considerable amount of tannin which they contain. The best food woods are elm, linden, maple, poplar and birch. When finely ground, these woods may be mixed with cereals and other foods for use by animals, and in emergency by man, and may be made to yield a considerable amount of nourishment.

Bran Does Not Irritate.

That bran is an excellent laxative is not a new discovery. The fact has been known for years and has been utilized by the farmer in the treatment of his horses, cattle and pigs, but, unfortunately, he has neglected to make use of this most excellent remedy for his own benefit. The general failure to resort to bran for the relief of constipation has probably been due to the wide-spread but erroneous notion that bran is irritating.

We are glad to find this view which we have so long defended endorsed by that most eminent of medical authorities, *The Journal of the American Medical Association.* We quote as follows (Dec. 6, 1919, p. 1768):

"Bran is therefore chiefly to be looked on as a form of almost indigestible carbohydrate, which is endowed with considerable laxative value, not only because it adds by its bulk to the distention of the intestine, but also because of the spicate shape of its particles. Excessive irritation does not result from these; for when properly moistened and heated, bran becomes as soft and pliable as wet paper, and hence produces *merely a gentle titillation* and is usable even in patients with a tendency to colic."

Some years before the same eminent medical journal published in its funny column the following:

"Dr. Kellogg says, 'Bran does not irritate, it titillates.' "

It thus appears that within a few years this humble food constituent has moved up from the funny column to the editorial department. So we are making progress.

Hippocrates was a believer in bran. In one of his famous medical works, he says,

"This I know, moreover, that to the human body it makes a great difference whether the bread be fine or coarse; of wheat with or without the hull. . . . Melancholic diseases are most particularly exacerbated by beef, for it is of an unmanageable nature, and requires no ordinary powers of stomach to digest it."

The writer quite agrees with Professor Tibbles, who asserts that "The excessive fear of indigestible foods which prevails in the minds of many people is largely responsible for atonic constipation and many of the cases of chronic intestinal catarrh, mucous colitis, and membranous colitis. It is therefore important in the treatment of these diseases that the food does not lack cellulose and especially woody fibre."

Von Noorden, one of the most eminent of living medical authorities, has for many years pointed out the necessity for roughage in the treatment of colitis, a disease for which bland foods are commonly prescribed. Von Noorden insists that in this disease the diet should include coarse bran bread, legumes, including the skins, coarse oatmeal, all sorts of coarse vegetables, fruits, currants, gooseberries and grapes, including the skins and seeds. Von Noorden reports complete and permanent cures of colitis by this regimen in 50 per cent of all cases, and cure or improvement in more than 75 per cent of all cases treated. More bran and less meat would be a good general prescription for the American people.

Bran contains a considerable amount of protein and when added in liberal quantities to other foodstuffs, excluding meat, might easily enrich the diet sufficiently to insure all the protein needed. It should be noted, also, that in addition to its richness in protein, bran contains a rich store of lime, iron and vitamins, important food constituents which are deficient in most other foodstuffs.

"Roger Crab, who died on 11th September 1680, lived for 3s. 3d. a year on broth and bran, with chopped turnip leaves, and drank only water. He had fought and was wounded in the Cromwellian army." (Sinclair).

The U. S. Department of Agriculture has published the results of experiments made at the New York Experiment Station which indicate that wheat bran is laxative not only because of its indigestibility which makes it a mechanical stimulant of the intestine, but because of the presence in bran of a peculiar laxative substance, phytin, which is found in very considerable amount in the outer layers of the envelope. This important discovery furnishes a scientific basis for the regular use of bran as a natural laxative which secures increased bowel activity not by irritating the bowel as do medicinal laxatives but by physiologic stimulation so that it may be used an indefinite length of time without losing its effects and without injury.

Carnivorous animals eat bones and other indigestible substances, doubtless to give increased bulk to their ingesta. Dogs often eat grass, and sea lions swallow quantities of pebbles (Norton).

Agar-Agar.

Agar occurs in commerce in long, flexible strings, which are imported to this country in huge bales. These strings do not consist of the dried seaweed, as many suppose, but is the cellulose which has been dissolved from the seaweed by boiling.

Some years ago, the writer obtained through Mr. George U. West, American Consul of Kobe, Japan, the following account of the method of preparing agar:—

"Japanese isinglass, or agar-agar, is made from six kinds of seaweed, the best qualities of which are found on the coasts of the Provinces of Izu, Tosa and Sado, and are known as Izu, Nanbu, Misaki, Onikusa, Egokusa, and Hirakusa. (Samples of the various kinds of seaweed mentioned are filed in the Bureau of Manufactures.) At the close of the summer the seaweed is bought up by wholesale dealers in Osaka and stored there in go-downs until sold to the manufacturers.

"The manufacture of vegetable isinglass, as its Japanese name, kanten (cold climate) would imply, can take place only in autumn and winter, as warmth and rain spoil the product. The process is simple, and the utensils employed are primitive. The factories are located at Ibaraki, in the mountains between Osaka and Kyoto, and at Nishinomiya, between Osaka and Kobe.

"The process of manufacture may be described as follows: The seaweed is first crushed, each kind separately, to remove shells and other adhering matter, and then washed with clean water. The washed seaweed is placed on a mat and dried until its color becomes white by the action of the sun, frost and dew. This operation takes place during September and October, and when bleached the weight of the seaweed is decreased nearly one-half. After bleaching, the six kinds of seaweed—in the proportion of Iza, 4; Egokusa, 4; Misaki, 3; Hirakusa, 3; Nanbu, 4; and Onikusa, 2—are all put together in a boiler and cooked for about 14 hours, until they become soluble. The liquid is then strained through a sack and a box with a bamboo sieve on one side, from which it runs into a container. From the container the liquid is ladled into trays about 3½ feet long and 3 inches deep.

"After remaining in the trays about 12 hours, these are placed on a low stand, and the isinglass is cut into strips 3 inches wide and 14 inches long, with a knife and a ruler. These strips are then put into a long closed wooden box (the ends of which are 3 inches square, one end being open and one filled in with a wire sieve) and pushed through the sieve end in the form of long fine strips. The isinglass is then placed on a low stand, which is covered with a clean mat, and dried in the sun during the day and during the night for two or three weeks during January and February, being watered at midnight. The quantity of the isinglass depends upon the weather during this time, the best being made when it is clear and cold, the poorest when it is warm and rainy. When the isinglass is bleached sufficiently, it is compressed and packed in Japanese matting, tied with a straw rope.

"The very best quality is all exported to China, the No. 1 quality that is shipped to America being equal to the No. 2 that goes to China."

It is evident that this crude method of preparation exposes the agar to contamination through the contact of insects, dust, etc. On this account commercial agar requires thorough disinfection and cleansing before use.

The use of agar is to be most highly recommended as a means of giving the necessary bulk to stimulate the intestine to prompt action. When properly prepared it is wholly free from unpleasant flavor, and it manifests such astonishing avidity for water that when it is present in the feces they cannot possibly become dry and hard.

In cases in which constipation is due to "greedy colon," agar or bran is indispensable. In such cases the colon has acquired the power to eat up enormous quantities of the cellulose of the food, so that it is very difficult to increase the bulk of the feces by the use of green vegetables. This is the reason for the disappointment experienced by many who hope to find in the free use of lettuce and like green foods a panacea for their intestinal ills. Agar has been shown by the experiments of Mendel and others to be indigestible by any of the digestive fluids with which it comes in contact in the human body. It must be taken in sufficient quantity to accomplish the object sought. Two-thirds of an ounce to an ounce daily is the quantity usually required for adults. For young children a quarter to a half of this quantity is sufficient.

Agar is easily taken in soup, cereal coffee, fruit juice or stewed fruit. It should be allowed to soften a little and should then be swallowed without chewing.

This remedy should be taken at meals in order that it may be well intermingled with the food, and so prevent the formation of hardened residues in the intestine.

Agar may be used with advantage as a substitute for a meal, when food cannot be taken, and when there is no appetite for food, and when so used it maintains the intestinal rhythm which would otherwise be lost, resulting in constipation. It should in such cases be taken with fruit juice or fresh or stewed fruit. When one finds at night that the usual amount of food has not been taken, an extra dose of agar with a little fruit may be taken before going to bed. No digestive work is required by either the fruit or the agar except to move it along the digestive canal. It is important to take fruit juice with the agar to excite the necessary peristalsis. Cooked bran may be used in the same way.

Some years ago, the writer received from a trained nurse working among the Indians at Hoonah, Alaska, an interesting specimen of dried seaweed which is collected by the Indians in the summer season for use as a laxative during the long winter months when berries and vegetable foods are not accessible. "After being gathered, the seaweed is spread out on the rocks and dried a little in the sun, then they fold it up and cut it in squares and put it in a coal oil can; a branch of spruce tree between each cake and a weight put on to press it. It is taken out and put in the sun day after day until well dried. The seaweed is used as a laxative, for which purpose they eat it raw."

The seaweed thus prepared occurs in blocks about eight inches square and an inch thick. It is jet black, and has a salty, though not unpleasant taste. It differs from Japanese seaweed in being very brittle so that it may be easily eaten dry.

Lewis and Clarke in their famous journey to the Pacific Coast more than a century ago, found the Indians making use of boiled moss as a foodstuff in the winter season.

Only among highly civilized people is there general neglect to include in the diet the necessary roughage to maintain a healthy action of the intestines. Savages take care to secure this food essential. The Eskimos eat half-digested reindeer moss from the stomachs of reindeer for laxative purposes.

Manyalla.

Mr. Kennan, in his fascinating volume, "Tent Life in Siberia," gives the following account of the use of partially digested reindeer moss by the Koraks:

" 'Hold on!' exclaimed Dodd, with a deprecating gesture, 'that's enough, I'll eat it;' and taking out a half-spoonful of the dark viscid mass, he put it to his lips.

" 'Well,' said we expectantly, after a moment's pause, 'what does it taste like?'

" 'Like the mud pies of infancy!' he replied sententiously. 'A little salt, pepper, and butter, and a good deal of meat and flour, with a few well-selected vegetables, would probably improve it; but it isn't particularly bad as it is.'

"Upon the strength of this rather equivocal recommendation I tasted it. Aside from a peculiar earthy flavor, it had nothing about it which was either pleasant or disagreeable. Its qualities were all negative except its grassiness.

"This mixture, known among the Koraks as 'manyalla,' is eaten by all the Siberian tribes as a substitute for bread, and is the nearest approximation which native ingenuity can make to the staff of life. It is valued, we are told, more for its medicinal virtues than for any intrinsic excellence of taste, and our limited experience fully prepared us to believe this statement. Its original elements are clotted blood, tallow, and half-digested moss taken from the stomach of the reindeer, where it is supposed to have undergone some essential change which fits it for second-hand consumption. These curious and heterogenous ingredients are boiled up together with a few handfuls of dried grass to give the mixture consistency, and the dark mass is then molded into small loaves and frozen for future use."

This half digested moss is much used by natives of the Arctic regions to combat constipation. It is also no doubt useful as a source of vitamins in which meat is very deficient.

The Acids of Foods

There are three wholesome food acids, that is, acids which are found in natural foods and which when eaten are utilized the same as starch, sugar and dextrine which they resemble in composition. These are citric, malic, and tartaric acids. In addition to these there are sometimes found in foods other acids which are not utilized by the body and hence are not foods, and which with one exception (lactic) are more or less harmful; these are acetic, oxalic, tannic, benzoic, butyric and uric acids.

Food acids are burned in the body like sugar and starch which they resemble as shown by their composition: citric acid, $C_6 H_8 O_7$; malic acid, $C_4 H_7 O_5$; tartaric acid, $C_4 H_6 O_6$.

The food acids, citric, malic and tartaric acids are chiefly found in fruits, but are also present in the juices of certain vegetable foods. With the exception of grape juice, citric and malic acids are the acids found in fruit juices. Most berries owe their acidity to citric acid, malic acid being present only in small amount. Malic is the chief acid of stone fruits and of apples.

Tartaric Acid.

Tartaric acid is found in quantity only in grapes, though traces have been detected in the pineapple and some other fruits. It is also present in small amount in potatoes, carrots, cucumbers and endive.

Underhill has pointed out that nephritis may be produced by tartaric acid when given freely in the form of tartrates, such as Rochelle salts. This fact assumes considerable importance when considered in relation to the extensive use of baking powders which usually contain tartaric acid in large amount. It is true that the amount of tartaric acid, or tartrates, required to produce acute nephritis is considerable,—much more than that ordinarily taken in the form of baking powder or even in a medicinal dose; nevertheless, this is no guarantee that profoundly mischievous results may not be produced by the long-continued intake of small doses of the acid, such as may occur in the free use of baking powders especially in cases of nephritis.

Malic Acid.

According to recent observations, (Wise) *malic aicd* is almost completely oxidized in the body, and large doses may be taken without producing any ill effect.

Malic acid is very widely distributed, being found in the following foods:

	Per cent.
Apples	.21 to 1.81
Pears	.11 to .50
Cranberries	.50
Cherry	.56 to 1.54
Currant	2.00 to 3.37
Gooseberry	1.7 to 2.6
Plum	.55 to 2.15

Grapes
Quince
Strawberries
Peach
Watermelon
Tomato

Greens
Beets
Asparagus
Spinach
Lettuce
Celery

Citric Acid.

Citric acid is the characteristic acid of lemons, and other citrus fruits, but it is at the same time found in many other fruits and some vegetables. The foods containing citric acid are as follows:

Oranges 1 to 2.5%
Grapefruit
Cherries
Legumes
Limes
Elderberries
Lemons 6 to 9%
Pomegranates

Strawberries
Currants
Gooseberries
Raspberries
Cranberries
Pears
Tomatoes
Radishes

Salant and Wise, of the Bureau of Chemistry, have shown (1917), that citric acid, either in the form of lemon juice or citrate of soda, is oxidized in the body, none being found in the urine even when doses as large as one ounce of citric acid were administered.

Phytic Acid.

Phytic acid, which occurs in small amounts in bran in the form of phytin, is worthy of mention because of its laxative properties to which it is claimed the bran of cereals owes, in part at least, one of its most useful properties.

Unwholesome Acids.

The unwholesome acids which may be encountered in foods are more numerous than the wholesome. Fortunately, they may be easily avoided. Those most commonly encountered are acetic, oxalic, tannic, benzoic, butyric, lactic, and uric acids.

Acetic Acid.

Acetic acid is chiefly met with in vinegar, which contains 3 to 5 per cent of this harmful chemical. It is formed by the fermentation of sugar. It is sometimes produced in the stomach. It may be recognized by its sour odor. It is a very highly volatile acid, and is always present when a sour odor is observed, as sometimes occurs in vomited matters and fermenting stools. It should be added, however, that the so-called "sour" or "acid" stomach is not often due to fermentation nor to acetic acid, but is the result of an excess of gastric (hydrochloric) acid.

Acetic acid is harmful to digestion, as first demonstrated by Sir Wm. Roberts. A teaspoonful of vinegar will at once arrest the process of salivary digestion in the stomach. Vinegar, as well as pickles, and all substances containing this acid should be banished from the table. It is a chemical compound of use only as a reagent in the chemical laboratory and in the arts. It is a poison, not a food.

When used freely in the form of vinegar or pickles, or in sauces, vinegar is an irritant to the stomach. Cases of ulceration of the stomach due to its use have been reported. Genuine cider vinegar is likely to abound in vinegar "eels," which it has been claimed may become parasitic in the human intestine.

Boix, of Paris, demonstrated some years ago by experiments upon animals that acetic acid has twice the power of gin to produce gin liver.

Lemon juice is more than a complete substitute for vinegar as an acid condiment. Vinegar is a useless and harmful chemical and should be excluded from the table.

Oxalic Acid.

Oxalic acid is found in minute amounts in many vegetable foods but in notable amounts only in a few. These are, rhubarb or pieplant, sorrel, spinach, tea, cocoa, and pepper.

All foods containing oxalic acid in any considerable amount should be parboiled and the boiling water rejected.

A study of Table XXIV will show that only the first six articles named contain oxalic acid in dangerous quantities, viz., cocoa, sorrel, pepper, rhubarb, spinach and tea. Pepper is used only in very small quantities and has other noxious properties sufficient to condemn it. Cocoa and tea being used as beverages, easily introduce a harmful amount of the acid. A cup of tea or cocoa contains about one-fourth grain of oxalic acid, four times as much as the body normally produces in a day, as shown by the amount contained in the urine, which is only one-fourteenth of a grain. Twice this amount is regarded as pathological. So a single cup of cocoa or tea introduces into the body twice as much oxalic acid as is needed to cause oxaluria, a diseased condition. And a cup at each of the three meals would load upon the body a dose six times as great as is known to cause disease. Evidently these drinks are harmful, if for no other reason, because of the oxalic acid which they contain.

In the use of spinach and sorrel, the oxalic acid should be carefully removed by parboiling.

With the familiar pieplant, or rhubarb, the case is different. This plant is used solely for its acid flavor which, unfortunately, is chiefly due to the presence of oxalic acid of which it contains, as shown by the table, seventeen grains to the pound or more than one grain to the ounce. An ordinary serving would contain about three grains of the acid. This amount is not sufficient to produce immediate ill effects in ordinary persons, although cases of sickness have been reported as will be noted later. But the amount is more than forty times that with which the tissues and the kidney are normally required to deal, and this quantity has been known to bring on acute relapse in a case of chronic nephritis, a disease often present though unsuspected.

It is well known that degeneration of the arteries and resulting high blood pressure may be caused by the use of water containing such minute quantities of lead that the presence of the injurious metal is not noticeable and can only be detected by careful chemical analysis. Metchnikoff has shown also that premature old age with degeneration of blood vessels, heart and other vital organs is due to the daily absorption of small quantities of poisons from the colon. It is not to be supposed that the taking of a small quantity of rhubarb now and then will produce any very appreciable effect on either health or length of life but the same may be said of wine, the use of beer, tobacco, tea, coffee and every injurious substance that might be named. It is, however, of the highest importance that the character of this plant should be generally understood, otherwise it would be quite possible for a person who happened to be quite fond of rhubarb to make use of it so frequently or freely as to suffer serious injury especially in cases of disease of the kidneys.

The healthy body is able to utilize, that is, oxidize or burn up citric, malic, and tartaric acid, but the tissues are unable to oxidize oxalic acid, which consequently passes through the body unchanged like a mineral acid. Four grams of oxalic acid is an amount which scientific inquiry has shown to be highly detrimental and productive of disease. For example, in those morbid conditions in which oxalic acid is supposed to be a factor, the amount of oxalic acid eliminated through the urine every twenty-four hours is only about double the normal amount. That is, oxalic acid is so injurious a substance that, if the amount ordinarily found in the tissues is doubled, highly pernicious consequences follow, among which are stone in the kidney, stone in the bladder and an extended group of distressing nervous symptoms which are included under the name of oxaluria. In view of these facts, it is evident that by the dietetic use of rhubarb it is easily possible to increase the amount of oxalic acid from twenty-five to fifty times the amount which clinical observation has shown to be capable of producing grave disease. Of course, a single dose of pieplant would produce only temporary effect, but the daily use of pieplant, by exposing the tissues constantly to the influence of this poison, must certainly be followed by deleterious effects, since no one has ever undertaken to show that the oxalic acid found in pieplant is in any way different from oxalic acid derived from other sources.

Some years ago, Sir Wm. Roberts, in experiments conducted for the purpose of determining the effects of alcohol and the various other substances upon digestion, demonstrated that oxalic acid has a most pernicious effect upon salivary digestion. A solution consisting of one part of oxalic acid in ten thousand parts of water was found to destroy at once all action of the saliva upon starch. Nearly thirty years ago, the writer very carefully repeated these experiments and was able to verify in every particular the observations of Sir Wm. Roberts. It is evident, then, that if pieplant is taken along with farinaceous foods, such as bread and oher cereals, potatoes, etc., the normal digestive action of the saliva upon the starch by which about half the work of starch digestion is normally accomplished in the stomach, must fail altogether. In other words, a very important part of the digestive work of the stomach is left undone when rhubarb is eaten.

Those who recommend rhubarb as a food will doubtless reply to the above criticism that nearly all vegetables contain oxalic acid. This is not questioned; but it is important that the public should know that while it is true that nearly all vegetables contain this acid, the amount contained in most vegetables is exceedingly small. There are only three vegetables commonly eaten which contain any considerably amount; namely, sorrel, spinach and pieplant. In the preparation of sorrel and spinach, the oxalic acid is dissolved in the cooking water and by parboiling may be practically all removed. But if this were done with pieplant no one would care to make use of it for it is used solely and exclusively because of the acid which it contains. That is, in the case of sorrel and spinach, the oxalic acid may be readily removed without impairing the food value of these articles. Whereas in the case of pieplant, removal of the oxalic acid would render it altogether useless and undesirable. The amount of oxalic acid contained in other vegetables than those mentioned is rarely so much as one-tenth the amount which these contain, and this small amount is left behind in the cooking water.

As regards the poisonous properties of oxalic acid we quote as follows from the United States Dispensatory:

"Attention was first called to it as a poison by Royston in 1814, and the certainty and rapidity of its action have caused it to be largely used for suicidal purposes. Death has been produced by it in ten minutes. The minimum fatal dose recorded is one dram (60 grains).

"When concentrated it causes exquisite pain, followed by violent efforts to vomit, then sudden dullness, languor, and great debility, and finally death without a struggle. When dissolved in twenty times its weight of water, it possesses no corrosive and hardly any irritating power, but causes death by acting on the brain, spinal marrow, and heart. It should be noted, however, that the acid, even in weak solution, always exercises a corroding or softening effect on the animal tissues.

"The morbid appearances caused by oxalic acid are various. In a dissection reported by Christison, the mucous coat of the throat and gullet had an appearance as if scalded, and that of the gullet could be easily scraped off. The inner coat of the stomach was pultaceous, in many points black, in others red, and that of the intestines similarly but less violently affected. In another case the whole villous coat of the stomach was either softened or removed, as well as the inner membrane of the oesophagus, so that the muscular coat was exposed, and this coat exhibited dark, gangrenous appearance, being much thickened and highly injected. The stomach usually contains a dark fluid, resembling coffee grounds, consisting chiefly of altered blood. The tongue and mouth are sometimes white or spotted with white."

After reading the above official description of the poisonous properties of oxalic acid, who would care to make this noxious substance a part of his bill of fare? That the toxic properties of oxalic acid are really present in pieplant is shown by the numerous cases of poisoning which have been reported in recent times. Here are a few:

The *Journal of the American Medical Association* published an account of ten cases of poisoning from eating canned rhubarb stems, the part usually eaten. Nine of the cases were in one family. Only one member of the family, who ate none, escaped serious illness. Two who had two helpings, had convulsions. The timely use of the stomach pump saved worse results. Chemical analysis showed no other poison present than oxalic acid in ordinary amount.

"A man of 41, his wife, four children and servants were all taken with violent diarrhea a few hours after having eaten a dish of rhubarb leaves cooked with spinach. All recovered rapidly except the man. He developed acute nephritis during the following week."

Tibbles reports cases in which persons who had previously suffered from nephritis (Bright's disease), suffered relapses after eating rhubarb. It may be easily understood that persons whose kidneys have been damaged by an attack of nephritis may be unable to deal with this highly irritant poison even in small amount. There are many thousands of such persons. The victims of typhoid fever, small pox, and even scarlet fever, measles and diphtheria, rarely escape more or less serious injury of the kidneys.

According to Thompson, the pieplant is not used as a food in Germany, being there grown only as an ornamental plant. According to an English monthly, *Illustrated Gardening,* the same is true in France. In the opinion of the writer the pieplant should be relegated to the list of noxious weeds. It is certainly not a wholesome food plant.

The fact shown by Pierson and Dutcher that rhubarb stems prevents scurvy in guinea pigs proves nothing in favor of its use by human beings. Grass and various weeds quite unfit for human food will also prevent scurvy in pigs.

TABLE XXIV.

Oxalic Acid in Various Foodstuffs per 1,000 Parts (Esbach).

Cocoa-powder	3.520 to 4.500
Sorrel	2.470 to 3.630
Pepper	3.250
Rhubarb	2.466
Spinach	1.910 to 3.270
Black tea	2.060
Beetroot	0.390
Haricot	0.312
Dried figs	0.270
Buckwheat flour	0.171
Common beans	0.158
Crust	0.130
Currants	0.130
Coffee	0.127
Crumb	0.120
Prunes	0.120
Chicory	0.103
Salsifies	0.070
Gooseberries	0.070
Plums	0.070
Raspberries	0.062
French beans	0.060 to 0.212
Good bread	0.047
Potatoes	0.046
Barley meal	0.039
Maize flour	0.033
Oranges	0.030
Lemons	0.030
Carrots	0.027
Cherries	0.025
Brussels sprouts	0.020
Endive	0.017
Lettuce	0.016
Strawberries	0.012
Parsley	0.006
Cauliflower	0.003
Tomatoes	0.002 to 0.052

Tannic Acid.

Tannic acid, a well known astringent, is found in some green leaves used as greens, but in amounts too small to produce noticeable effects. It is also present in minute quantities in certain fruits. But tea, coffee, and cocoa contain this harmful acid in large amounts. Tea, for example, contains tannic acid to the extent of one-eighth its weight. A single cup of tea contains seven to fifteen grains of this astringent drug which renders great service to the tanner of hides, but is obnoxious to the stomach and a hindrance to digestion through precipitation of the pepsin of the gastric juice.

Coffee contains tannic acid in still larger amount than tea, roasted coffee containing as much as 45 per cent. of caffeotannic acid, or nearly half its weight. The injurious effects of coffee upon digestion are thus distinctly worse than in the case of tea.

Cocoa contains much less tannin than either tea or coffee.

It is a mistake to suppose that the tannin of either tea or coffee may be avoided by care in brewing. Tannic acid is the most readily soluble of all the constituents of tea and so dissolves out first. The longer the tea is steeped, of course, the larger the proportion of the solid ingredients that will be dissolved.

Benzoic Acid.

Benzoic acid is found in certain fruits, especially cranberries, plums and prunes. The use of these fruits tends to render the tissue fluids and the urine acid and to cause acidosis. Persons with a tendency to acidosis or who suffer from gout, ''gravel'' or uric acid calculi of the bladder should avoid foods containing this acid.

Benzoic acid is an antiseptic, and for this reason it has been extensively used as a preservative, especially in canned fruits, apple cider, catsup and other sauces. A small amount—one-twentieth of one per cent—is tolerated by the pure food law. Dr. H. W. Wiley very properly opposed the use of this unwholesome chemical in any quantity. Its use should be forbidden and all preserved foods containing it should be avoided.

Butyric Acid.

This acid results from the fermentation of certain fats. It is found in rancid or ''strong'' butter and other fats. It is a poisonous acid and often gives rise to acidosis in children and in diabetics when an excess of fats is eaten.

In starvation, the body is compelled to live upon its stored up fat, and the results are much the same as when an excess of fats or an exclusive fat diet is eaten. A certain amount of starch or sugar (2 to 3 ozs.) is required daily to insure the complete combustion of fats and prevent the development in the tissues of the harmful butyric acid and other poisonous bodies derived from it.

Butyric acid in the food is highly irritating to the stomach glands, exciting an excessive secretion of gastric acid. Persons suffering from hyperacidity or diabetes should carefully avoid the use of strong butter or rancid fats. The butter used by such persons should be freshly prepared from sterilized cream.

Butyric acid is often produced in considerable quantity in the colon when Welch's bacillus or *B. butyricus* is dominant. There is much foul smelling flatus and the stools have a very strong rancid odor. In such cases the colon should be emptied by an enema twice a day, using sugar water—three or four pints, 2 ozs. of malt sugar or milk sugar to the pint—and the flora should be changed as quickly as possible. (See p. 552).

Rancid, strong smelling stools in an infant indicate the necessity for reducing the fats of the diet at once.

Boix of Paris ten years ago made experiments upon rabbits which demonstrated the toxic character of butyric acid. An animal weighing about nine pounds was given half a gram of butyric acid (7½ grains) daily with its food. It died at the end of four weeks, having diminished in weight 40 per cent. Examination showed its liver to be in a state of atrophic sclerosis (gin liver).

Lactic Acid.

While not a food, *lactic acid* is non-poisonous, rarely harmful, and renders real service in helping to maintain a healthy condition of the intestines, especially of the colon.

Lactic acid is produced in the body by the fermentation of sugars by certain bacteria. Two beneficent organisms, the *B. bifidus* and the *B. acidophilus*, take possession of the intestine within a few hours after birth. They produce lactic acid and no harmful substances. The lactic acid formed in the colon stimulates the colon to normal action. So long as these germs remain dominant in the intestine, other germs, especially the germs which causes putrefaction, cannot obtain a foothold. The stools are not putrid and the bowels move normally.

The lactic acid of sour milk and buttermilk is not unwholesome, but is of no particular assistance to the colon for the reason that it is not likely to reach the colon. The ordinary bacteria of sour milk cannot live in the colon. Buttermilk prepared from the *B. acidophilus*, is of great service in restoring the protective flora to the colon, not because of the lactic acid which it contains, however, but because of the presence of acid-forming bacteria which are native to the colon and capable of thriving there under favorable conditions, and of lactose, their best nutrient.

Many years ago, about 1895, the writer began to use enemas of buttermilk with marked success in the treatment of colitis. Later, whey cultures of *B. acidophilus* have been used.

When the stools are putrid, the colon is paralyzed by the ammonia and other alkaline substances present. The buttermilk enema not only removes the offensive matters but replaces the paralyzing alkalies with stimulating acids.

Lactic acid is a physiologic stimulant of the colon. A dram of this acid in two or three pints of water is a most efficient means of emptying the colon in cases of obstinate constipation.

Three ounces of milk sugar or an equal amount of dextrine taken three times a day for a week or ten days will change the bacterial flora of the intestine so as to make the *B. acidophilus* dominant, and cause the production of a sufficient amount of lactic acid in the colon to produce increased bowel activity.

Uric Acid.

Uric acid is one of the waste or excretory products of the body. It results from the work of the living cells. It is, like other waste products, poisonous to the living tissues, and when it is not promptly and thoroughly removed from the blood by the kidneys it is often deposited in the tissues, giving rise to gout and many other grave disorders. An excess of uric acid is also a cause of renal calculi, so-called gravel and bladder stones. Failure to eliminate uric acid is one of the first indications of disease of the kidneys. This condition is shown by an increase of the amount of uric acid normally found in the blood.

It was formerly supposed to be a part of the duty of the liver to convert uric acid into urea, which is readily eliminated by the kidneys. It is now known, however, that uric acid is an end product of metabolism; that is, that it undergoes no further change in the body. The human liver is unable to convert uric acid into urea. This function is possessed by the livers of carnivorous animals, such as the dog and the members of the cat family; but the liver of man, as well as that of the chimpanzee, orang-outang and other members of the family of primates to which man belongs, do not possess the power to detoxicate uric acid by converting it into urea.

The significance of this fact will be at once apparent when attention is given to the work of Dr. Hall, of Manchester, who made a study of ordinary foodstuffs in relation to their uric acid content, and found that flesh foods of all sorts contain large amounts of this waste product. Beefsteak and lean meats generally were found to contain as much as 14 grains of uric acid to the pound, or 27 grains to 1,000 calories of food value. Sweetbread was found to contain five times as much, or 70 grains to the pound, more than 135 grains of uric acid to 1,000 calories. It will readily be seen that with a flesh diet enormous quantities of uric acid may be thrown into the circulation and thus a very heavy burden may be imposed upon the kidneys. The late Prof. E. G. Janeway called the writer's attention to the fact that the kidneys of the meat-fed house cat are usually found in an advanced state of degeneration.

Milk contains no uric acid. Sterile eggs are also free from uric acid; fertile eggs contain uric acid in small amount after the process of incubation has begun. Vegetable foods with few exceptions are practically free from uric acid. Beans contain a small amount, 2.5 grains per 1,000 calories or less than one-tenth as much as beefsteak contains. This small amount can be practically removed by parboiling.

TABLE XXV.

Uric Acid in Foods (*Hall*)

Food	Per Cent.	Grains per Pound
Cod-fish	.058	4.07
Plaice	.079	5.56
Halibut	.102	7.14
Salmon	.116	8.15
Tripe	.057	4.00
Mutton	.096	6.75
Veal: Loin	.116	8.14
Pork: Loin	.121	8.49
Ham (fat)	.115	8.08
Beef: Ribs	.113	7.96
Sirloin	.130	9.13
Steak	.206	14.45
Liver	.275	19.26
Sweetbread	1.006	70.40
Chicken	.129	9.06
Turkey	.126	8.82
Rabbit	.097	6.31
Oatmeal	.053	3.45
Peameal	.039	2.54
Haricot beans	.063	4.16
Potatoes	.002	.14
Onions	.009	.26
Asparagus	.021	1.50

The Toxic Effects of Uric Acid.

While it is more than probable that many disorders for which uric acid is not responsible have been frequently charged to its account, it nevertheless cannot be denied that uric acid is a highly toxic excretory product and that the tissues should be kept as free as possible from it. Since it is now known that the human liver is not able to convert uric acid into urea or some allied non-toxic substance, it is clearly evident that one who wishes to live long and preserve his liver and kidneys intact to a good old age must eliminate uric acid from his dietary as fully as possible. There is no doubt of the truth of the statement by Tibbles that "The persistent consumption of foods containing a large percentage of purin bodies (uric acid) is apt to lead to their accumulation in the organism. So long as the liver can transform (?) and the kidneys excrete purin bodies, no harm, it may be thought, will follow. But a constant irritation of the kidneys by an excess of purins, especially uric acid, may result in chronic nephritis of the gouty variety, with other evidences of chronic gout. The retention of purins in the system is amongst the reognized causes of gout, rheumatic gout, uric acid gravel, uric acidaemia, migraine, neuralgia, sciatica, epilepsy, vascular diseases, and many other conditions of ill-health."

To avoid uric acid it is practically necessary to do nothing more than to cut out meats from the dietary, for the amount of uric acid found in beans and other vegetable foods is too small to be of any significance.

Normal Food Acids do not Acidify the Blood and Tissues.

Until comparatively recent times it was supposed that food acids, like the mineral or fixed acids, tend to acidify the blood and the tissue fluids, and on this account all acids were forbidden in rheumatism and other disorders in which acids were supposed to be present in the body to excess. It is now known that this is an error. The food acids are quickly burned up in the body like starch, sugar and dextrin.

Another fact of as great or greater importance is that the acids of foods are not free, but exist in combination with the alkalies, soda and potash, so that when the acid is burned up the soda and potash are left behind. It thus appears very clearly that the real effect of food acids is to alkalinize the blood and tissue fluids.

Wholesome Foods

There is probably no other animal that includes in its dietary so large a variety of substances as does man. In fact, the human race, taken as a whole, exploits the bills of fare of the whole animal world. There can be found scarcely a plant, a bird, a beast, a fish or a reptile eaten by any animal that is not also eaten in some form by some man. In addition, man has produced a great number of artificial foods some of which are denatured to such a degree as to make them unacceptable to many intelligent members of the animal kingdom. There are, indeed, few if any animals that could be induced to eat a spiced pickle or any one of a dozen common dishes which might be named.

And man essays this complex and varied bill of fare without a digestive apparatus adapted to so complicated and difficult a task. Like the man-like apes, the chimpanzee and the orang-utan, he has a simple digestive machine adapted to the digestion of fruits, nuts, soft grains, juicy roots, eggs and milk. His digestive system includes no mechanism corresponding to the gizzard of the barnyard fowl, the quadruple stomach of the bovine, or the seven-gastric-power digestive machine of the whale. He has only the simple, rather feeble stomach of the primate, the aristocrat of the animal kingdom, adapted to the digestion of the choicest and most delicate of nature's tidbits, to dine on the top shelf of Mother Nature's pantry, so to speak, and yet, with this delicate simian stomach, he does not hesitate to tackle the world's bill of fare, to do gastronomic stunts from which the hardiest beast of the forest might well recoil.

Under such treatment, it is no wonder that the human gastric machine has broken down, and that dyspepsia, constipation, and peristaltic woes of various description have become universal in civilized lands. Dinner pills and post-prandial sousings of mineral water have become a part of the national regimen, but even the stout odors of the modern perfumer cannot hide the disgusting flavor of my lady's breath which makes loud advertisement of the fact that there is an embargo in the large intestine with an unsavory accumulation of decaying food residues.

A return to biologic living is the most pressing economic as well as the most necessary physiologic reform required at the present time.

To eat biologically is simply to eat scientifically, to eat normally. This the average man seldom does for two reasons: First, he does not know how to do so, having lost largely his nutritive instinct, so that he has no safe guide, such as even the humblest of the lower animals possesses; and second, because wholesome food is in many places almost unattainable on account of the ignorance of cooks and caterers.

The purpose of this section is to present in as concise a form as possible the known facts concerning the individual foodstuffs which experience and scientific research have established.

The author has endeavored to avoid wasting space in commonplace descriptions merely for the sake of completeness. Most of the data concerning caloric value, reaction balance, and iron and lime content, will be found succinctly summarized in tables, thus making this technical data more readily available for reference than if crowded into the text of the book.

Calory Values of Foods.

The calory, as more fully explained in another chapter, is the modern unit of heat and of its equivalent in other forms of energy. The calory is a useful measure of food value because food is oxidized or burned in the body, as in a furnace, though by a flameless mode of combustion.

The calory value of a food is not, however, the only measure of its nutritive qualities, for there are other food essentials beside fuel value. A substance may be a good fuel, while a very poor food or even a poison, as in the case of alcohol or gasolene. A food may have a high fuel value and yet possess a low food quality because of indigestibility. Again, a food may be easily digestible, as in the case of polished rice, and of high calory value, and yet possess inferior merit as an exclusive food because of its lack of vitamins. Thus, in estimating the value of a foodstuff, we must take into account all its properties and not its calory value alone.

Nevertheless, it is of first importance to keep in mind the calory values of the foods eaten as well as their content of lime, iron, with other salts and vitamins.

Methods of Converting Percentages in Food Composition Into Calories Per Ounce.

As the composition of foods is usually given in percentage, while dietetic prescriptions are usually made in calories, it is useful to know how quickly to convert percentage figures into an equivalent expression of calories per ounce. The caloric value of protein and of carbohydrate is approximately 4 calories per gram, that of fats, 9 calories per gram. These figures allow a small margin for waste through non-absorption. To convert percentage values of protein and carbohydrates into equivalent calories per ounce, it is only necessary to multiply the percentage figures given by 1.136, or approximately one and one-seventh. The calory ounce equivalent of fats is found by multiplying the percentage figures by 2.56, approximately two and one-half.

Changes in Food Produced by Cookery.

Man has been defined as a "cooking animal" and for ages the culinary art has been highly cultivated and made the means not only of utility but of harmful luxury. Through modern scientific research, we are coming to know that notwithstanding its great service to the human race, the art of cookery has associated with it many perils, one of the greatest of which,—the most recently recognized,—is the fact that it destroys vital elements and so modifies the food as to greatly impair its nutrient value. The beasts of the forest, and to a large extent also the primitive savage, take their food directly from the hands of nature, unsophisticated and uninjured, and as a result enjoy an immunity from disease and acquire a vigor and toughness of constitution which are unknown to civilized man. The chef of the future will display his finest talents, not in the compounding of complex combinations of foods with non-foods and poisons, into disease-breeding entrées and desserts, but in selecting and serving in wholesome and attractive ways the pure products of Nature's great food laboratories—the garden and the farm.

According to Professor Jordan, of the University of Chicago, the people of the stone age were not acquainted with the art of cooking and ate their food in the raw or natural state. Cooking utensils only made their appearance a few thousand years ago.

The cook stove is a necessity to meet the artificial needs of our conventional human life. In a primitive normal environment, the cook stove could be easily dispensed with. It is a wonderful convenience and very greatly enlarges our bill of fare, but is not at all a necessity provided the right selection of foodstuffs, those biologically suited to man's needs, can be made.

The use of fire in the preparation of foods dates from prehistoric times. Baking, roasting, boiling, are employed by the most primitive tribes in the preparation of foods. Long before metal vessels were in use, and even in the absence of stone vessels, boiling was done by dropping heated stones into water held in wooden vessels or even tightly woven baskets. Some of the wild tribes of India cook rice by placing it with a quantity of water in a hollow section of green bamboo, and dropping this into the fire. In whatever way cooking is done, its purposes are to change the consistency of the food, to develop palatable flavors and to render it more digestible. Cookery is, in fact, a sort of predigestion as regards the starch content of the food. When moisture and heat are applied to starch, it swells up, the granules rupture and the raw starch is converted into a simple form of dextrin known as amylo-dextrin, which gives to gelatinized starch or starch paste its adhesive properties. As ordinarily employed in cookery, starch is gelatinized at a temperature considerably below the boiling point. Different starches require different temperatures for gelatinization.

The temperature required for the gelatinization of different starches is shown in the following table (Grindley):—

Oats	185° F.
Barley	176° F.
Rye	176° F.
Wheat	176° F.
Rice	176° F.
Maize	167° F.
Potato	149° F.

In cooking with water or steam, the cellulose is softened and the gums dissolved, and pectose is gelatinized. This permits the food particles to fall apart. For this reason, cooked food is more readily soluble in the stomach and sooner passes out into the intestine.

It is interesting to note that potato starch, which is digested by the saliva much more easily than the cereal starches, is also much more readily dextrinized by heat.

A higher temperature, such as that to which bread is subjected in baking, still further dextrinizes the starch, but no amount of heat will convert it into sugar, although starch as well as sugar is caramelized by a sufficiently high temperature.

It is evident, then, that the effect of cooking upon starch is to render it more readily digestible. This may or may not be an advantage.

In the case of protein, the opposite effects are produced. Lean meat, like the albumin of egg, is hardened by a temperature of 160 degrees or more. The white of egg exposed to heat just sufficient to curdle it is thereby rendered easily digestible, while the raw white of egg passes through the alimentary canal with little change, being practically indigestible. When white of egg is exposed to a higher temperature, as in boiling, the albumen is hardened to such an extent that it becomes difficult of digestion.

The same is true of meat and other albumins. The heat to which they are exposed in boiling, roasting, frying, etc., renders these nitrogenous substances less digestible than in their native state.

Fats, through exposure to heat are likewise rendered less digestible. Emulsions exposed to heat tend to break down. The fat globules when heated run together, forming large masses which are less easily digestible and must be again emulsified in the process of digestion.

Sugars are not changed by cooking unless they are exposed to a temperature above 212 degrees. At higher temperatures, the sugar is caramelized to some extent and its sweetness is lessened.

When cane sugar is boiled in the presence of acids, an inversion takes place which lessens its sweetening properties.

Exposure of foods to the boiling temperature destroys the antiscorbutic vitamin and may lessen the value of other vitamins present.

Boiling foods in water, if the water is thrown away, robs them of dextrin, sugar, vitamins, soluble salts and other valuable nutrient elements.

It is thus apparent that the cooking of food has its disadvantages as well as advantages. It cannot be denied, however, that the bill of fare which man everywhere has adopted, would be practically impossible without cookery. The cereals which constitute the staple food of both civilized and semi-civilized sections of the human race, are in their native, dry state unsuitable for human sustenance. The same is true of most of the succulent roots which enter into our ordinary dietary.

Sustenance upon uncooked food is only possible when a very careful selection of foodstuffs is made. Such a bill of fare would necessarily consist of ripe fruits, nuts, tender shoots, succulent roots containing little or no starch, such as the turnip and the ground-nut and cereals in the milk state, with milk and eggs.

Eggs taken in a raw state could hardly be regarded as wholesome because of the indigestibility of the raw white of egg, recently discovered, and the increase of intestinal putrefaction when the raw white of egg is eaten.

Meat is digestible in a raw state even more readily than in the cooked state, but is readily accepted by no member of the primate family except when hard pressed by hunger.

TABLE XXVI.

Showing Percentage of Water and Solids in Various Articles of Food Before and After Cooking.

	Cooked		Uncooked	
	Water	Solids	Water	Solids
Arrowroot	93	7	16	84
Beef	57	43	71	29
Cabbage	97	3	89	11
Carrots	93	7	86	14
Cod	76	24	82	18
Haddock	68	32	78	22
Lamb	67	33	72	28
Lentils	66	34	12	88
Mutton (leg)	51	49	63	37
Oatmeal	92	8	13	87
Onions	99	1	82	18
Peas, dried	62	38	14	86
Peas, green	87	13	75	25
Vegetable Marrow	99	1	95	5

The following Table (Grindley) shows the amount of water in raw vegetables and the same vegetables after boiling:—

TABLE XXVII.

Showing the Gain of Water by Vegetables in Cooking.

	Per Cent of Water in Raw State	Per Cent of Water After Cooking	Increase
Parsnips	82.0	97.2	15.2
Artichokes	80.0	91.6	11.6
Cabbage	89.0	97.5	8.5
Spinach	90.0	98.0	8.0
Cauliflower	90.8	96.4	5.6
Sea-kale	93.3	97.9	4.6
Vegetable marrow	94.8	99.1	4.3

According to Professor Snyder, 100 pounds of cabbage contain 7½ pounds of solids, of which more than one-third, 2½ to 3 pounds is lost when the cabbage is cooked in water.

Carrots cut in small pieces and cooked in water lose 20 to 30 per cent. of their weight. Potatoes lose little if cooked in their jackets.

Spinach has a solid content of 10 per cent., of which nearly one-fourth is lost when the spinach is cooked in water and drained.

Celeriac has a solid content of 9½ per cent., of which half is lost by boiling in water.

Curly greens, borecole, loses half the weight.

When boiled in water, rice, if the water is poured off, loses so large a proportion of its valuable nutrients that native Indian soldiers preferred the liquid drained off, leaving the residue for the British.

Vegetables in general are more weighty after cooking than before. If there is loss in weight it is because of the loss of nutrients. One hundred ounces of green artichokes weigh, after cooking, 336 ounces; Brussels sprouts, 121 ounces; leeks, 252 ounces; lentils, 238 ounces; Quaker oats, 1,110 ounces; rice, 418 ounces.

Raw Food Diet.

Some years ago, the practice of feeding exclusively upon raw foods was strongly urged by certain faddists. The argument used was that exposure to heat destroys the vitality of the food and thus lessens its nutrient value. The idea was extensively exploited and commercialized by certain adventurers under whose unscientific instruction hundreds of people subjected themselves to a dietary better adapted to horses and oxen than to human sustenance.

The majority of these victimized persons soon learned the error of their ways and returned to more rational methods of feeding, often after suffering more or less damage.

Not infrequently, however, persons who adopted the raw food diet found themselves appreciably benefited by the change, doubtless because their diet had previously been deficient in vitamins.

Another advantage of the raw food diet which may, perhaps be one of its chief merits, is the fact that it supplies to the colon a considerable amount of raw starch which, being digested and converted into dextrin and sugar by the unused ferments always present in the feces, furnishes the kind of nutriment necessary to encourage the growth in the colon of acid-forming or fermentative bacteria, thus combating putrefaction and encouraging normal bowel action.

It may fairly be said that while it is doubtless true that the art of cookery has rendered possible the existence of human beings under conditions which would otherwise have been impossible, and has probably been the means of preserving the human race under circumstances which might otherwise have wrought its extinction, this art has nevertheless wrought much mischief through the unwise manner in which it has been employed. The art of cookery has been used not only to render food more digestible, but more often to lessen its digestibility and to transform the simple, wholesome products of Nature into noisome, disease-producing mixtures.

The fact that primitive man took his food in a raw or uncooked state is sufficient evidence that it is possible to subsist upon foods in the state in which they are provided by the hand of Nature.

In addition, it must be said that there is good ground for believing that there are certain qualities possessed by raw foods which render them an important and even indispensable part of the normal diet, even though one may not go so far as to exclude cooked foods altogether from his diet.

According to Hon. W. N. Beaver, for many years a magistrate in Papua, New Guinea, the natives of Kiwai, formerly ate their rice raw. The Scotch Highlanders have from time immemorial eaten their oatmeal simply scalded.

A person who desires to live upon a raw diet, in arranging his bill of fare cannot base his selection upon the supposition that all raw foods are complete nutrients, but must possess a sufficient knowledge of the newer facts pertaining to nutrition to enable him to make such combinations of foodstuffs as will constitute an aggregate complete in all the elements required for perfect nutrition and in adequate quantities; in other words, a diet which supplies, in addition to a sufficient amount of fats, carbohydrates, salts and cellulose, a proper proportion of complete proteins and an abundant supply of the various vitamins essential to good nutrition. It is thus apparent that a diet consisting exclusively of fruits and nuts might not meet these requirements. Such a diet would meet all nutritive needs as regards proteins, fat and carbohydrates, but might be notably deficient in roughage, vitamins and salts. Certain nuts, if taken in sufficient quantity, would furnish the needed quantum of iron and lime, but there would still be a deficiency of cellulose and vitamins.

For a complete dietary, it would be necessary to add to fruits and nuts a liberal supply of green leaves in the form of greens, lettuce or similar foodstuffs. On such a diet, well selected, life might be well sustained for an indefinite length of time.

Jolles, of France, has shown that the blood contains ferments which he calls katalases, the function of which is to set free oxygen from the oxyhemoglobin. These ferments are found in healthy blood in large quantities, but they are greatly diminished in tuberculosis, nephritis, carcinoma. The intensity of oxidation depends upon the amount of katalases present. It is possible that the reducing ferments which abound in raw fruit and vegetable juices may be of service to the body in conditions in which the oxidizing ferments are deficient in the blood.

There is some ground for believing that the remarkable influence upon nutrition exercised by the juices of fresh or uncooked fruits and certain vegetables is due to certain enzymes which are destroyed by cooking. Some of these enzymes very closely resemble those which are found in the body. For example, Professor S. H. Vines reported in 1902 the discovery of ferments in plant juices capable of digesting albumin. The same investigator later discovered that these proteolytic ferments are found in pineapple juice, in the milk of the cocoanut, and in the juices of melons, cucumbers, tomatoes, grapes, pears, oranges, bananas, lettuce, cabbage, green peas, onions, potatoes and turnips.

By means of cookery, grains and vegetables can be made to furnish adequate quantities of the chief elements required to satisfy our nutritive needs, and by supplementing these foodstuffs with greens and dairy products and an adequate supply of fresh, uncooked foods in the form of fruit, celery, lettuce and other salad plants, it is possible to meet nutritive needs at a minimum of expense and inconvenience.

Finally, it is to be said that while we cannot easily dispense with cookery, we must take care to use the art in such a manner as to avoid the injuries which it is capable of producing, and must not neglect to include in the bill of fare a sufficient amount of natural foodstuffs "untouched by fire," to make certain of supplying to the body an ample amount of the subtle products which are found in natural foodstuffs—such as vitamins—and which are damaged or destroyed by cooking. An exclusive diet of fresh or uncooked foods may be adopted for a change now and then with advantage. Taking such a diet for a day or two every two or three weeks is an excellent means of stimulating intestinal activity and keeping the intestinal flora in good condition, and in some cases of obstinate constipation, a continuous diet largely made up of fresh foods is found highly beneficial.

Cereals

The cereals are seeds for the most part derived from grass-like plants. The most important cereals are rice, wheat, oats, corn, barley and millet, to which may be added buckwheat and the less known quinoa and kaoling.

The cereals are among the oldest of foodstuffs used by man. Very likely they were first used in a half ripened, the so-called "milk" state, when they are very palatable and readily digestible. Some varieties of green corn are quite as palatable without cookery as with. In tropical countries cornfields are often robbed by apes and baboons, whose dietary is believed to be essentially the same as that of primitive man.

Cereals, like most other seeds, consist of three essential parts: (1) A germ which represents the future plant; (2) a store of nutrient material consisting of a considerable volume of starch, a smaller amount of protein and a still smaller quantity of fat, together with ferments for the digestion of the starch and protein and vitamins for the promotion of the growth of the new plant, with food lime, food iron and other salts; (3) a protective covering to preserve the stored nutrient material from injury by the elements and the attacks of bacteria and insects.

An interesting fact which has received little attention until very recent years is that the several essential elements named, all of which are essential not only for the proper nutrition of the plant, but equally for the nutrition of the eater of the seed, are not homogeneously distributed throughout the seed but are very unequally placed. For example, the carbohydrates, starch and sugar, are almost wholly found in the center of the kernel; the protein, vitamins and salts are, on the other hand, found in the layers of cells placed just beneath the outer covering of the seed. Certain of the vitamins are found almost altogether in the germ.

The importance of these facts will be recognized when it is remembered that vitamins are made only by plants, and hence, when seeds are depended upon as a staple article of diet, they are the only source from which this important element can be obtained.

From the foregoing it is plain that if seeds are to be used as food, the whole seed must be employed. The covering of the seed, or bran, and the germ contain precious elements which are essential for complete nutrition. Ignorance of this fact has resulted in the death of many thousands of persons annually in rice-eating countries. It is stated on good authority that until the importation of polished rice was forbidden not less than 15,000 people died annually from beri-beri in the Philippine Islands alone.

In general, the cereals are deficient in lime even when the outer covering or bran is not removed. The fat-soluble vitamin, one of the most important growth-promoting vitamins, the absence of which produces night blindness and other evidences of degeneration, even complete destruction of the eyes in rats and other animals when fed exclusively on a grain diet, is lacking in cereals except in the germ. By sprouting the grain, however, the amount of vitamins present may be increased to so great an extent as to supply the deficiency.

The Protein of Cereals.

Some years ago Rubner reported experiments which seemed to demonstrate that there is a great difference between the different cereals as regards the nutritive value of their proteins. The proteins of corn were thought by Rubner to be much inferior to those of wheat. Recent observations made by Sherman, and later by Osborne and Mendel, have shown that there is little or no difference in the nutritive value of the proteins of wheat, corn, oats, rye, and barley. Sherman showed that nine-tenths of the protein might be derived from any one of the cereals named provided the remaining tenth was obtained from milk or apple. The protein of milk is known to be very excellent in character, superior in fact to meats of any sort, and the protein of the apple appears to be about equal in value.

The Iron Content of Cereals and Breads.

It is first of all worthy of remark that while cereals are as a class poor in lime, they are comparatively rich in iron. A pound and a quarter of graham bread will supply a day's ration of iron, while four times as much would scarcely furnish the lime required for one day to make good the body's loss of lime salts. Even corn, which is so deficient in lime as to require 8 pounds for one day's lime supply, contains sufficient iron for one day's needs in a little more than a single pound.

The average iron content of all the cereals and breads is sufficient to supply in one ounce or in 100 calories more than one twenty-fifth of a day's needs.

Of all the cereals, the highest in iron content is the entire wheat, of which 11 ounces supply a day's iron ration. Barley, rye, oatmeal, and graham flour come next and in the order named, supplying three-fourths as much.

Graham bread contains three times as much iron as does white bread, twenty-five per cent more than "pumpernickel," fifty per cent more than entire wheat bread, rye bread and soda crackers.

Graham bread supplies in 14 ounces a whole day's iron ration or four times as much iron as polished rice, white flour, or hominy, more than five and a half times as much as corn meal, four and two-thirds times as much as farina, three times as much as macaroni, buckwheat flour or rye flour, and twice as much as "pumpernickel," pearled barley, brown rice or tapioca.

Boston brown bread makes a better showing than any other of the breads because of the molasses in its composition, furnishing in a seven-ounce loaf iron enough for a day. As a practical source of food iron, oatmeal deserves special mention, 14 ounces supplying a day's ration.

The cereal foods which show so great a deficiency in iron as to properly put them in a list of foods only to be eaten when adequately supplemented by foods extra rich in iron, are white bread, corn meal (new process), farina, hominy (toasted corn flakes are made from hominy grits), macaroni, buckwheat, polished rice (toasted rice flakes and puffed rice), and tapioca.

The Lime Content of Cereals.

Of the six great cereals, wheat, corn, barley, rye, oatmeal, and rice, the last named feeds many millions more of human beings than any of the others. The countless millions of the Orient are fed chiefly upon rice. Both polished and brown rice are in use throughout the densely populated countries of Asia, from Korea to Java. Of all the cereals and the several seeds which serve food purposes, rice contains the least lime, only one-fourteenth of a grain (.073 grs.) per ounce in brown rice and one-eighteenth (.055 grs.) in polished rice. Wheat contains four times as much lime as brown rice, rye five times as much, and oatmeal six times. Corn is the only rival of rice in poverty of lime, having only a little more than one-fourth as much lime as has oatmeal.

Instinct seems to have informed the Orientals of the deficiency of rice in lime salts, for they invariably combine with it a liberal amount of legumes of some sort or of greens or fresh or salted and dried turnips. All of which foods are very rich in lime salts.

It is true, as stated, above, that wheat contains four times as much lime as rice, but this is only true of "entire" wheat, that is, of wheat, wheat meal, or graham flour, which includes the bran and "shorts." Fine white flour contains less than half as much lime as does entire wheat and only one-sixth as much as does wheat bran. Its lime content is but little above that of rice and is just equal to that of corn and pearled barley, one-eighth grain of lime to the ounce (.122 grs.). More than 7½ pounds of fine flour, whole corn or pearled barley, or 10½ pounds of fine flour bread, are required to furnish one day's ration of lime. The polished rice in common use in this country is so poor in lime that 17½ pounds barely suffice to furnish the 15.4 grains required to meet our daily needs.

Evidently, a rice diet is highly deficient in bone making material and must greatly impoverish the blood and tissues in lime content when adhered to for more than very brief periods.

The U. S. Government has prohibited the importation of polished rice into the Philippine Islands for the protection of the Filipinos from beri-beri and lime starvation, but no protection is afforded the loyal citizens of this country against the same danger. Every American citizen is permitted to indulge in lime starvation to the full extent of his ignorance and inclination.

The rice question is not, however, of such commanding importance in this country as in the Philippines, because rice is here used rather as a delicacy or a luxury than as a food staple, as in the Philippines. This may be due in part to the higher price of rice as compared with other grains, but is perhaps still more due to general lack of acquaintance with the many superior qualities of rice, a grain which aside from its deficiency in lime, is undoubtedly the finest of all the cereals. Nevertheless, the consumption in this country of billions of pounds of rice annually, involving a deficiency of thousands of tons of lime in the national bill of fare is one very real cause for the increasing prevalence of bone diseases and teeth decay in the United States, at least in certain sections.

A danger of identical character exists in certain sections of this country, especially in the South, where corn meal is almost as important a food staple for large groups of the population as is rice in the Philippines and in South China and the Malay Archipelago. Corn pone is the chief item in the bills of fare of some millions of negroes and small white farmers in Alabama, Tennessee, Georgia, Kentucky, Louisiana, Arkansas, and the Carolinas. A pound of corn meal per capita is probably not an overestimate of the amount daily consumed by the classes indicated. The 16 ounces of corn should supply at least 12 grains of food lime, but actually does furnish one and three-fourths grains (1.76 grs.), or about one-seventh (.15) the amount required. In view of this fact, it is no wonder that these poorly fed people present many evidences of physical deterioration.

It is still a question with the physiologists who are making a study of pellagra, whether this disease may not be due in part, at least, to a deficiency of lime. The free use of molasses which contains more than a grain and a half of lime to an ordinary serving of 1¼ ounce, may to some degree mitigate the evils which might otherwise follow the use of a foodstuff so greatly lacking in lime salts.

The same may be said for the use of milk in connection with both rice and corn meal. The combination of molasses and milk with corn meal makes good its deficiency in lime, but milk adds also other essential elements and so is greatly preferable to molasses.

Still more deficient in lime is hominy, and also corn flakes which are made from grits, a corn product which represents the interior of the kernel wholly separated from the outer, lime-containing layers. Hominy is even more deficient in lime than is brown rice, containing, in fact, but little more lime than does polished rice. For a day's supply of lime one would have to eat more than 14 pounds of hominy or corn flakes. Instead of 12 grains of lime to the pound, as does milk, hominy and corn flakes contain only one grain.

Buckwheat flour is another defective food, containing but little more lime than polished rice, less than one-sixteenth of a grain per ounce (.061 grs.). Fortunately, perhaps, the conventional buckwheat cakes served hot from the griddle as a breakfast dish are usually eaten either with molasses or maple syrup, both of which are rich in lime as is also Malt Honey.

Breads Are Deficient in Lime.

All the breads, with the exception of Boston brown bread and bread made from the entire rye meal, the pumpernickel of Central Europe, are notably deficient in lime. Even graham bread contains only one-sixth the normal proportion of lime, (which is ¾ grain to 100 calories) and rye bread has scarcely half the ideal proportion.

As a class, the cereals are notably deficient in lime and must be supplemented by other foodstuffs rich in lime salts. Fortunately, such foods are not lacking. By the use of the nuts and fruits already mentioned as desserts, and by the regular addition to the bill of fare of legumes, greens and milk products, any deficiency may be easily made good.

But we must not close our discussion of the cereals without a further word concerning oatmeal, the richest of all the cereals in lime salts. An ounce of oatmeal supplies a little less than half a grain of lime (.425 grs.). In Scotland, where from very ancient times oatmeal has been the great food staple of the peasantry, it constitutes so large a proportion of the total food intake that it becomes a highly important source of lime salts. The Scotchman eats oatmeal not only in the form of brose, a dish resembling mush made by pouring hot water on oatmeal which is thus scalded but not well cooked as in this country, but also as "bannocks," scones and other forms of bread.

Whatever the oatmeal lacks of supplying the full quota of lime is made up by the cabbage, greens, kale, and buttermilk which are universally and freely used by the shepherd farmers of the Scotch Highlands. In the Highlands, a common practice is to scald the oatmeal with the water in which cabbage, kale, or collards, has been cooked. When thus prepared, the porridge, known as kale brose, is extra rich in lime salts and affords another example of the instinctive demand for mineral food elements made by the natural appetites of human beings who have not lost their normal instinctive guides through the cultivation of unnatural tastes.

The good results of this liberal supply of food lime are well shown in the tall and brawny figures of the Scotch Highlanders and doubtless accounts for the world wide reputation for vigor and toughness enjoyed by these hardy grain feeders.

In the United States oatmeal is comparatively a new acquaintance. It was not until the "Centennial Exhibition" at

Philadelphia where oatmeal was very adroitly exploited as "Avena" that this cereal came into general favor as a breakfast food in this country.

In more recent years, oatmeal has been largely displaced by toasted flakes and other breakfast foods made popular by adroit advertising. As eaten, the actual amount of the dry material in an ordinary serving of corn flakes or rice flakes is little more than an ounce and the amount of lime supplied is too small to cut any figure of importance in the lime ration.

A cereal product which has long been used by farmers in the feeding of horses, cattle, pigs and chickens, but has only recently come into use by human beings, is wheat bran. While low in caloric value, as its chief constituent is cellulose, bran is a most valuable supplementary food, not only as a source of bulk to stimulate the intestines, but as a source of lime and iron. Every ounce of bran contains three-quarters of a grain of lime, sufficient to balance one hundred calories of food principles. By the addition of sterilized bran in liberal quantity, the deficiency in lime of various cereal preparations, breads, mushes, etc., may be made up. Bran may also be added to potatoes and other vegetables which are deficient in lime.

Finally, it must be said concerning the cereals that while they are the world's staple foods for working animals as well as for working men, they are perhaps made to constitute a somewhat too large proportion of the bill of fare in most civilized countries. As pointed out by Bunge many years ago, and confirmed by other authorities, the cereals contain an excess of the fixed acids, particularly sulphuric acid, and on this account when used too freely they upset the nice balance between acids and bases or alkalies in the body, and produce a relative acidosis to which numerous ailments are attributed. This tendency may be successfully combated by the liberal use of fruits and vegetables, especially potatoes, which contain an excess of bases, although greatly deficient in lime, a fact which must be borne in mind and which requires compensation by the addition of a suitable amount of foods rich in lime salts, such as milk, lentils and greens.

WHEAT

Wheat is one of the oldest of our cereal foods. It has come down to us from prehistoric times. According to Chodat, the ancestor of wheat was the wild *emmer*, a grass plant which is still found growing wild in Asia Minor.

Wheat is perhaps the most important of our American cereals, although in size the annual crop produced is much inferior to corn. The whole grain contains about one-eighth its weight of protein, 70 per cent. starch and 2.4 per cent. cellulose. It is deficient in vitamins, lime and iron; hence should not be used as an exclusive food.

The gluten of wheat, which comprises almost the entire protein content, consists of about equal parts of gliadin, a vegetable gelatine, and glutenin. It is obtained by washing out the starch.

As produced by Nature, the wheat berry contains no elements which are not essential for nutrition. Rats fed on whole wheat flour thrive and produce young, while rats fed on white flour do not thrive and fail to produce young, or if they do, the progeny are feeble and do not thrive. Dogs fed exclusively on bread made from patent roller flour died on an average at three weeks, whereas dogs fed exclusively on whole wheat flour were hearty and thriving at the end of 30 days. Pigeons fed on fine flour bread soon lose weight and develop beri-beri. If the diet is continued they die, but if fed on whole grain, or whole grain with the addition of yeast, they recover. There can be no doubt that the outer covering of the grain, that is, the bran, is necessary for complete nutrition. Tibbles, an eminent English authority, says with reference to fine flour,

"The miller and the baker have impoverished the flour and bread of some of the most important constituents of the wheat grain, viz., the *vitamins, enzymes, activators, amino-acids* and *lipoids,* which only exist in the germ and subpericarpal layers of the bran of wheat. The removal of these substances does not matter very much in the case of well-to-do families, where fresh milk, animal foods and vegetables containing *vitamins* are constantly a part of the daily diet. But it matters greatly to the children of the poor, whose chief diet is white bread."

Bread Making.

Bread is perhaps the oldest of all prepared foods. According to Pliny, the earliest Romans were wholly unacquainted with bread, but used instead a porridge prepared from parched grain. This simple mode of cooking cereals is still in vogue in widely separated parts of the world, as among the North American Indians and the wild natives of Mexico, who still show great preference for parched corn mixed with water. The gofio of the Canary Islanders is another example of the same. The ancients prepared their bread from crushed cereals mixed with water, with or without the addition of oil. The art of bread making was known in ancient Egypt, but was known still earlier in Switzerland, as shown by the relics found in prehistoric lake dwellings, which include not only grinding stones for making flour but charred loaves of bread.

The sweetest and most wholesome bread is that made from the whole meal of the grain mixed with water, with perhaps the addition of a little salt and baked in thin cakes or small loaves. Bread is made in this way by the native Mexicans, the wandering Arabs, tribes in northern India, and various other primitive people. The beaten biscuit of Virginia, famous for their toothsomeness, is a water bread in which the dough is made to rise by air well beaten in with a hammer.

Yeast bread is not unwholesome when prepared from good yeast; in fact, the yeast may possibly add something to the proportion of vitamins contained in the bread. When eaten warm, however, raised bread is objectionable on account of the fact that the center of the loaf is in a pasty condition and in chewing is rolled into small masses which are not easily penetrated by the digestive fluids. Bread should always be allowed to stand a sufficient length of time to permit the center or crumb of the loaf to become friable so as to crumble when rubbed between the thumb and finger instead of forming a pasty ball.

Some alcohol is produced in the raising of yeast bread, but this is practically all driven off by the heat to which the bread is exposed during the process of baking. If bread is not sufficiently baked, the yeast and other ferments will not be killed, some alcohol will remain, and the result will be a continuation of the fermentation by which the alcohol will be converted into vinegar; in other words, the bread will sour. Bread, properly baked, will have a hard, friable crust on all sides.

Recent observations by Wahl have shown that bread is improved by the addition of buttermilk or sour milk, the lactic acid present serving to dissolve the phosphates of the flour, to render the proteins more soluble, and to otherwise improve the quality of the bread. In European countries nut meats are added to bread with advantage.

Bread should always be wrapped with paraffin paper at the bakery and before it has had any opportunity for exposure to insects or contamination by the hands of workmen. Automatic wrapping machinery is now employed for this purpose in all first-class bakeries.

Baking Powders.

The best baking powders are prepared from bicarbonate of soda and bitartrate of potash. In the chemical reaction which occurs between these two chemicals, carbonic acid gas is set free. This, in rising through the loaf, forms small cavities through the tenacity of the gluten and thus makes the bread light. The chemical combination of the constituents of the baking powder results in the formation of rochelle salts, a laxative drug. The use of baking powder is doubtless preferable to the old-fashioned soda or saleratus and sour milk method still much in use in the Southern States, but is more or less objectionable not only because it leaves an unusable chemical substance in the bread, but because the alkalies present damage the vitamins, as pointed out by Funk.

Count Rumford long ago showed how to raise bread by the use of hydrochloric acid (C. P.) and bicarbonate of soda. The acid and soda combine, setting free the carbonic acid gas and leaving as a residue only a small amount of chloride of soda or common salt, the quantity being less than is commonly used as seasoning. The proper proportions are 80 minims of acid to a level teaspoonful of soda bicarbonate for two cups of flour. The dry soda is well mixed with the flour and the acid is added to the liquid, which should be cold. The ingredients are then mixed as speedily as possible and put at once into a hot oven. The amounts of soda and hydrochloric acid given above are equivalent to four level teaspoonfuls of baking powder.

Baking powders are superfluous as aids to good cookery. They are convenient, but non-essential. The very best and sweetest bread possible may be made without them. What could be more toothsome, for example, than the famous "beaten" bread of Virginia or the "hoe cake" of the South, a mode of bread making learned from the North American Indian. The tortillas of Spanish America and the unleavened cakes of the Arabs are other well known examples of toothsome bread made without yeast or baking powder and used by millions of people with entire satisfaction.

It cannot be claimed by any one possessed of a modicum of knowledge of human physiology that the daily use of a cathartic drug even in small amount can be otherwise than harmful. The use of baking powders may be, indeed, an insidious cause of constipation.

Says Professor A. E. Taylor, of Philadelphia,

"We must not, however, be oblivious to the fact that a saline cathartic residue results from the reaction of every form of known baking powder now commonly employed."

Underhill has shown that rochelle salts cause nephritis in animals. It is reasonable to believe that the long continued use, even in small quantities, of a drug that in somewhat larger doses will cause inflammation of the kidneys in animals cannot be a wholesome practice. At least the avoidance of baking powder products by persons suffering from chronic nephritis may be insisted upon as a wise and reasonable precaution.

Wheat Bran.

One-fifth of the weight of wheat consists of bran, but this small portion contains three-fourths of all the salts and nearly all the cellulose of the entire berry. Whole wheat contains 4 grains of lime to the pound, fine flour only 1 grain, and lime 12 grains.

A pound of whole wheat flour contains 37 grains of potash. A pound of bran contains 119 grains of potash, while a pound of fine flour contains only 11 to 12 grains of this important element.

Bran contains one-twentieth of its weight of salts, one-thirtieth of its weight of phosphate of potash, and 7 to 11 times as much salts as are found in fine flour.

Ordinary bran contains about one-third cellulose, 37 to 100 times as much as does fine flour. Another third consists of starch. In addition, there are about 3 per cent fat and 12 per cent protein.

It is astonishing that we should habitually throw away such a large amount of most valuable food material. The evil consequences of this waste are simply enormous, really beyond estimate.

The loss of potash, according to Dr. Ross, an eminent English authority, predisposes to cancer, and is perhaps one of the leading causes of cancer. The loss of the cellulose which is necessary to give bulk to the food leads to constipation, a veritable mother of maladies. By the use of 1/3 to 1/2 ounce of bran, daily, regular bowel movement may be secured in the majority of cases of constipation. Many obstinate cases are relieved by adding simple exercises and the use of paraffin oil.

Decay of the teeth is often a result of loss of lime from the body. The teeth are robbed of their lime to supply the deficiency resulting from the use of fine flour bread, cane sugar, meat, and other foods deficient in lime. Half an ounce of bran taken daily with other food will aid in supplying the body with necessary mineral elements and thus help to check decay of the teeth and injury to other of the bone structures.

How to Use Bran.

Bran cannot be well eaten by itself. It must be combined with other foods. There are numerous excellent combinations which have been well tested and found satisfactory.

First of all, it is necessary that the bran itself should be of good quality. Ordinary bran is very dirty, abounding in germs of many sorts, and also weevil and other insects. To be wholesome as food, bran must be prepared from thoroughly sound wheat, which must be very well cleaned, brushed, and washed before grinding. The bran should then be sterilized so as to make sure that it is thoroughly free from bacteria. If prepared in the home, the bran should be carefully selected, thoroughly washed, and baked in an oven until well cooked.

This cooked bran may be mixed with different cereals in various proportions. Among the most practical combinations are bran and oatmeal, bran and corn meal, and bran with rice. Bran may also be combined with purees of potato and other vegetables. The proportion should be about one part of bran by weight to three parts of oatmeal, corn, or rice, or equal parts by bulk. The steel-cut oatmeal is better for this purpose than rolled oats. As the bran has been thoroughly cooked in sterilizing, it does not require long cooking. The oatmeal and bran mixture is made very palatable by cooking six to ten minutes, and has a better laxative and antitoxic effect than when long cooked. Sterilized bran may also be added to ordinary Graham flour to increase its richness in salts and cellulose, and may thus be used in the preparation of mush, gems, rolls, bread, crackers, etc. The very finest bran bread possible may be made by adding cooked bran to good spring wheat flour. The proportion should be about one part of sterilized bran to six of flour. Housewives nearly always have difficulty in making Graham bread, for the reason that the diastase of the bran acts upon the starch, converting it into dextrine, making the loaf sour or heavy. This difficulty is obviated by the use of cooked bran, or by sifting out the bran of

Graham flour, and boiling or baking it, then returning it to the flour.

The Anti-Graham Campaign.

One of the most meretricious of the many venial exploitations to which the public are at the present time being subjected is the campaign against the use of graham bread or flour prepared from the whole wheat. It is evident that this campaign is being carried on altogether in the interest of the millers, who for years have been exacting an enormous toll for their production of superfine, denatured flour which represents only a fraction of the nutritive value possessed by the whole wheat berry. The primary assumption of the millers is that they know more than does Nature concerning the nutritive needs of the human animal. Their object, of course, is not to promote the welfare of the public, but to enrich their own pocket books.

It is now nearly eighty years since Sylvester Graham, from whom graham flour and graham bread derived their distinctive name, started his nation-wide campaign in favor of whole wheat meal. His propaganda was urged with great earnestness, but after twenty years his disciples were few. In the writer's boyhood, graham flour could not be purchased west of Rochester, New York. It was only to be gotten by buying at the mill the various products obtained by grinding wheat and mixing these together in the proper proportions; but within the last 60 years the Graham idea has rapidly extended and at the present time graham bread is obtainable at every bakery of any size in nearly all parts of the country. Graham bread is found upon tens of thousands of American tables daily. Besides, the people have become accustomed to the use of whole grain preparations in various other forms, such as wheat flakes, shredded wheat and oatmeal. It is quite too late to now come forward with scarecrow doctrines about indigestion, malnutrition and sundry other evils likely to result from the use of whole grain preparations. The people were fooled by these arguments for many years but now have their eyes open.

The purely mercenary motives of the propagators of these doctrines at the present time may be clearly seen in the fact that the same mills which employ skilled writers to instruct the public about the dangerous consequences likely to result from the use of graham flour because of the small percentage of bran which it contains, employ other writers to extol the marvelous virtues of bran in substance and the importance of making regular use of it daily and even at every meal. The public have learned by experience the value of bran as a substitute for the nauseous pills and mineral waters with which the American stomach has so long been persecuted.

A report that graham flour was the cause of illness and even deaths in Belgium during the war has been much exploited by the millers. There is good reason to believe that the real cause of the sickness was a cargo of spoiled wheat which was shipped from the West to Belgium after having been rejected as unfit for milling.

CORN

Maize, or Indian corn, is distinctly an American product and has been justly termed "the Indian's gift to civilization." Luther Burbank has proved this invaluable grain to be probably a lineal descendant of a Mexican plant, *teosinte*, a member of the grass family which grows wild on the table lands of Mexico and Central America.

In nutritive value, whole corn slightly exceeds wheat. It is less rich in protein than is wheat, and its protein, according to the observations of Rubner and others, is less valuable as a nutrient than is the protein of wheat. Its two proteins, zein and glutelin, are very unequal in nutritive value. Animals fed on zein by Osborne and Mendel did not thrive, while those fed on glutelin were well nourished. By the addition of milk, however, the deficiencies of zein are compensated so that a diet consisting of corn mush and milk is a combination well adapted to the nutrition of the body.

Mr. George K. Cherrie, a well-known naturalist who accompanied Mr. Roosevelt in his South American exploration, and who recently returned from his twenty-eighth expedition to the American tropics, reports that the diet of the natives of Venezuela is corn and goat's milk. That this diet is sufficient for complete nutrition is shown not only by the good health and great endurance of the natives of the country, but by the fact that Mr. Cherrie himself lived for many weeks at a time on the native diet, and mentions no ill effects from the simple bill of fare.

A staple diet of cow's milk and corn would be a simple and effective solution of the problem of the high cost of living, at least so far as food is concerned. Our corn crop alone, if fed exclusively to human beings and dairy cattle, would more than suffice to feed our whole population of 100,000,000 people.

Of course it is not to be expected that the national bill of fare will ever be made so simple as this, but the facts presented afford ample evidence of the great economic advantage of a simple regimen from which superfluities and harmful luxuries are eliminated.

The aborigines of America made corn their staple food. Said Dupratz, writing in 1763, "All the nations who inhabit from the sea as far as the Illinois and even further, carefully cultivate the maize corn, which they make their principal subsistence."

The Peruvians, from the most ancient times have subsisted chiefly upon corn, as they do at the present day. The writer has in his possession an ear of corn recovered from an ancient tomb near Lima, Peru, which is believed by the authorities of the American Museum of National History to have been interred not less than 2000 years ago. In appearance it does not differ from our modern hard corn.

TABLE XXVIII.

*Showing the Composition of Corn Products.**

Kind of Material	Water %	Protein %	Fat %	Starch, Sugar, Etc. %	Crude Fibre %	Mineral Matters %	Fuel Value per Pound Cal.
Corn, whole grain, average	10.8	10.0	4.3	71.7	1.7	1.5	1,795
Corn with low protein content	10.5	6.0	3.8	78.5		1.2	1,685
Corn with high protein content	10.5	12.9	4.4	70.8		1.4	1,695
Corn, white	11.4	10.8	5.0	68.8	2.5	1.5	1,690
Corn, yellow	11.9	10.7	4.8	68.9	2.2	1.5	1,690
Sweet Corn (matured)	8.8	11.6	8.1	66.8	2.8	1.9	1,750
Sweet Corn (green)	73.0	5.0		19.5			446
Pop Corn	10.7	11.2	5.2	69.6	1.8	1.5	
Hominy, fine	11.0	9.4	.7	78.2	.4	.3	1,810
Samp, coarse	10.8	8.3	.5	79.4	.4	.3	1,770
Corn Meal (whole grain ground), unbolted	12.0	8.7	4.7	71.1	2.2	1.3	1,850
Corn Meal (whole grain ground), bolted	12.0	8.9	4.9	72.0	1.2	1.0	1,765
Corn Meal, granulated	12.5	9.2	1.9	74.4	1.0	1.0	1,770
Corn Starch				90.0			1,675
Corn Syrup	16.0			83.5		.5	1,120
Corn Oil			100.				4,040

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*Farmers' Bulletin 298, U. S. Dept. of Agriculture.

Corn Meal.

The old-fashioned hoe cake and corn meal mush, prepared from meal made from the entire grain, sometimes called "water meal" because ground on stones turned by the old time water wheel, are the best modes of utilizing corn as food. New process corn meal is robbed of much of its salts; and corn bread made in the modern fashion, with sour milk and saleratus or baking powder and a liberal admixture of lard is still further deteriorated. Old style corn meal, mixed with water and a little salt and baked in thin cakes, the method still used in many parts of the Southern States, is the finest corn bread possible.

Corn Meal Mush and Milk.

Hart and Steenbock, in experiments upon pigs, have shown that for the best results milk and corn meal must be used in equal quantities. It is necessary to provide sufficient milk protein to balance the incomplete protein of corn. In the mixture named, the milk would furnish about 30 per cent. of the protein. This homely dish, long approved by common experience, is now shown to be a highly scientific combination.

Corn Oil.

Corn oil is prepared from the germ of the grain, which constitutes about one-tenth of its weight. The old process corn meal contains the germ and the entire grain with the exception of the outer skin. The germ is removed by the new process, and the oil, which constitutes more than four per cent of the weight of the grain, is separated and subjected to special processes of purification, the final product of which is corn oil, a wholesome vegetable oil which is as digestible as other varieties of vegetable oil although it is lacking in the fat soluble vitamin which is found in butter, and hence is not a complete substitute for the dairy product.

White and Yellow Corn.

The chemical composition of white and yellow corn is essentially the same, although they differ in flavor because of the characteristic aromatic substances found in the oil. Hess has recently claimed that carotin, the colornig matter of yellow corn, contains the important fat soluble growth-promoting vitamin which is found in butter, from which it would appear that yellow corn has a somewhat greater value as a nutrient than has white.

Grits.

Hominy and samp contain about 10 to 20 per cent less protein and 10 per cent more carbohydrate than the entire grain. They contain only one-fifth as much of salts, being almost wholly deficient in food minerals.

Corn Starch.

Corn starch is a preparation of corn from which all but the starch has been removed. It contains 10 per cent water, the balance being carbohydrates in the form of raw starch granules.

Corn Syrup.

Corn syrup, or glucose, consists of corn starch which has been subjected to the action of a mineral acid and heat and thereby converted into a form of sugar. When thoroughly purified from the chemical substances used in the process of its manufacture, it is probably not unwholesome, although it cannot rightly be regarded as a complete substitute for the sugars and other carbohydrates found in the sweet juices of fruits and other saccharine foods.

Pop Corn.

Pop corn is one of the most wholesome of cereal foods. It is easily digestible and to the highest degree wholesome, presenting the grain in its entirety, and hence superior to many denatured breakfast foods which are found in the market.

Everybody is familiar with the method of popping corn. It is notorious, however, that the corn sometimes pops more readily than at other times. In order that it shall "pop" well it is necessary that the kernels should contain a certain amount of water. A good plan is to soak the pop corn in water over night, then allow to air dry until it no longer feels moist, the surface appearing dry. It is now ready to pop. A method of popping which produces particularly excellent results is the following:—

Put in a large iron kettle half a pint of cooking oil of some sort. Heat nearly to boiling point. Drop in a pound of shelled pop corn prepared in the manner above directed, stirring gently. The corn pops at once and fills the kettle, making about six quarts. Honduras rice may be popped in the same way, and is very toothsome. Popped rice prepared in this manner is much used in China.

Green Sweet Corn.

This delicious vegetable, for which we are indebted to the North American Indian, is a product of our gardens during late summer and early fall. The ears are picked when the grain is in the milk state; that is, when the carbohydrates are still largely in the soluble form of sugar and dextrine, which later are converted into insoluble starch for storage. Sweet corn contains about 13.5 per cent. of starch, 6 per cent. of sugar, and 5 per cent. of protein. It is usually prepared by boiling or roasting. Roasted ears are much sweeter than boiled for the reason that in boiling the sugar is largely lost in the cooking water. Steaming is a better mode of cooking than boiling, and the finer varieties, especially the yellow bantam and Mexican varieties, are entirely acceptable to the palate when eaten uncooked, and are at the same time more wholesome.

Toasted Corn Flakes.

Toasted corn flakes is a breakfast food prepared from white corn grits by a process of which the following constitute the several successive steps:

1. Cooking at a temperature above the boiling point.
2. Drying.
3. Tempering by the addition of water or steam.
4. Milling by means of mills specially constructed for the purpose by means of which the grits are flattened out into large flakes.
5. Toasting in a traveling oven.
6. Salt and other flavorings are added in the process of cooking.

This product, devised by the author many years ago, in an effort to provide palatable dextrinized cereal foods for the patients of the Battle Creek Sanitarium, was at first designed to be eaten dry as the best means of stimulating the action of the salivary glands and to encourage the practice of thorough mastication. Eaten with milk, corn flakes constitute an excellent breakfast food. It must be acknowledged, however, that when eaten moist with milk or cream it offers no better nutrient than the old-fashioned brose of the Scotch peasantry, or the corn meal mush of our childhood days. It cannot be doubted that all our efforts to improve upon Nature's products by artificial manipulations are more or less futile and often result in a denaturing which lessens their value as foodstuffs.

Gofio.

The Indians made porridge from corn which had been parched and then pounded into a coarse meal. Corn and other grains are used in this way by the natives of the Canary Islands under the name of *gofio.*

Corn lacks the glutinous property necessary for bread making by the yeast process commonly used with wheat flour, but Chodat claims to have discovered a ferment by means of which good raised bread can be made from corn flour.

OATS

The oat has for hundreds of years been the staple food of the hardy natives of the Scotch Highlands, but it is only within comparatively recent years that oatmeal has become a common article of diet in this country, and still more recently that its use has become common in other parts of the British Islands than Scotland and Ireland. Even at the present time oatmeal porridge is rarely found as a component of dietaries in Continental Europe. When Johnson issued the first edition of his dictionary, oatmeal was so seldom used in England that he felt justified in defining the oat as a food for men in Scotland and for horses in England. When chided by a Scotchman for the opprobrious suggestion implied in his definition, Johnson rather testily retorted, "And is it not the truth?" Whereupon the Scotchman, after a moment's hesitation, admitted the statement to be a fact, but added, "And where do you find such foine horses as in England and such foine men as in Scotland?"

As a human food, the oat is far superior to corn. It is rich in lime, which is almost altogether lacking in corn, besides containing considerable fat. Its nutritive value is so great that a single ounce of oats represents an amount of energy equivalent to more than 150 foot tons, which is more than double the energy represented in an ounce of lean meat, nearly double the energy value of bread and more than four times that of the potato. Prepared in the form of brose and bannocks, the oat is still the staple article of diet of the Scotch Highlander; and when supplemented with buttermilk and potatoes, it forms, from a nutritive standpoint, an ideal diet for securing the fullest degree of physical development and maintaining a high degree of energy and endurance.

A very old writer, Sinclair, tells us in his "Code of Health" that "In their ancient predatory incursions into England . . . the Scottish warriors fastened to their saddles a bag filled with oatmeal and a plate of flat iron, upon which they baked their grain into cakes. Laying this iron plate, called a griddle, upon a fire, they spread upon it their meal, made with water into a thin paste, and thus converted it into bread. They could carry a sufficient supply of this for thirty days' consumption, which gave them great advantages over an army whose wants were more numerous."

The brose of the Scotch consists of oatmeal stirred into boiling water until the mixture thickens, then removed from the fire and served at once. The meal prepared in this way is scalded rather than cooked. It is, nevertheless, highly palatable. After an experience of some years, the writer is prepared to recommend this as by far the best method of preparing oatmeal porridge. Cooked in the ordinary way until it becomes a slimy pasty mass, oatmeal is constipating; but prepared after the Scotch manner, the porridge contains a sufficient amount of uncooked starch to produce a laxative effect. The raw or imperfectly cooked starch being more slowly acted upon by the digestive juices is able to reach the colon before absorption takes place. Starch in the colon supplies the nutrient material necessary to encourage the growth of acid-forming bacteria and the production of acids, thereby preventing putrefactive changes with the formation of poisons and encouraging intestinal activity. The food residues are thus promptly discharged from the body instead of being retained to undergo putrefaction and produce autointoxication.

The "bannocks" of the North of England consist of thoroughly kneaded oat dough rolled into thin cakes and baked on an iron plate suspended over the fire.

RICE

This cereal feeds more human beings than any other. It is the staple food of hundreds of millions of human beings in India, Burma, China, Japan, and other Oriental lands. Its nutritive value is high and its productivity great. Many varieties are grown, some requiring submergence, others (upland rice) adapted to dry soils.

Rice takes the place of bread, potatoes and breakfast cereals, all three in one, in the Oriental diet. The Chinese coolie works long hours on rice; the Japanese jinriksha boy carries his "fare" long distances at the rate of six miles an hour on a diet of rice and refuses to substitute the meat which contact with modern civilization has introduced to Japan, because it destroys his endurance. The toiling millions of Southern Europe have within recent years come to appreciate more and more the value of rice, and in this country, where wheat and barley have been grown from remote ages, rice is steadily gaining ground in popularity through its greater digestibility and energy-supporting properties.

Rice contains a smaller amount of potash salts than any other of the grains, as pointed out by Bunge, and is on this account the least irritating to the tissues and leaves the least residue for elimination by the kidneys of any cereal. It will be tolerated by the stomach when almost no other food will be received without protest.

The rice diet, described elsewhere, is of special value in cases in which there is great irritation of the tissues of the mouth, esophagus or stomach and in acute disorders of the kidneys.

Dr. S. A. Knapp of the United States Department of Agriculture, himself a sufferer from impaired digestion, seeking for a diet which might afford him relief from the distress of indigestion, recalled the fact that rice eaters while performing prodigies of work complained of hunger between meals, due to the fact that rice leaves the stomach within an hour and so gives this organ an opportunity for rest. Dr. Knapp remarks: "This was precisely what I wanted—energy with hunger. I had it as a child and lost it somewhere in a busy life. Rice-eating nations have energy with unimpaired digestion." Dr. Knapp also calls attention to the fact that the Japanese soldiers subsisting on a ration of rice were able to outmarch all the armies of European nations in the advance upon Peking at the time of the Boxer uprising. "With full equipment they advanced all day at double time, and repeated it until even the Russians fell behind exhausted." The jinriksha boys of Japan travel all day carrying a heavy passenger at the speed of a horse; in fact, there are very few horses that can maintain, day after day, the pace set by these hearty rice eaters.

Rice is low in protein, containing only a little more than half the amount of protein contained in wheat, but its protein is of a superior quality so that its actual value is, as a nitrogenous nutrient, not materially less than that of wheat. Rice contains a smaller amount of salts than any other of the cereals. The amount of lime and iron which it contains is almost *nil*.

Polished Rice.

In the form in which rice is used in this country, it is not only lacking in salts but in vitamins, and hence should be regarded as a deficiency food which should never be relied upon as a chief nutrient. When polished rice is used, it is well to take at the same meal a quantity of wheat bran. This may even be mixed with the rice with advantage, It detracts from its appearance but completely restores the wholesomeness which is lost by the polishing of the rice. A good rule is to mix with the rice about half its volume of sterilized bran. The bran should be mixed with the rice before it is added to the boiling water. In a similar way bran should be added to new process corn meal. Oatmeal is also improved by the addition of bran.

It would be to the advantage of the people of this country if the manufacture and sale of polished rice were forbidden. The Filipinos are in this respect better protected from disease than are the people of the United States.

The great attention which has been given to the development of the rice industry in India in recent years is well shown by the fact that in the rice exhibition held in Bengal in 1906-7, nineteen distinct classes of rice were exhibited, among which were, drought-resisting varieties of rice, flood-resisting rice, rice which can be grown on hillsides without terracing, autumn maturing rices which produce fine grain, winter rices which grow on salt lands without protection by embankments, rice producing four to six grains in each head, rice, the whole plant of which is fragrant, black rice, the leaves of which are also black, rice which may be eaten without boiling, wild rice, rices which mature in three months, and rice which requires nine months to produce a crop.

Wild rice grows in great abundance in shallow lakes in many parts of the United States. It was a staple food of the American Indian in pre-Columbian days and is still used by them. It is a delicious cereal. It is gathered in boats, then dried and slightly roasted to insure keeping.

BARLEY

Barley has been so long used in making beer that its value as human food seems to have been largely forgotten, at least in English speaking countries. Barley is believed to have been the first of the cereals to be used as human food. Barley cakes are mentioned in the most ancient accounts of the eating habits of man.

In composition barley much resembles wheat, although it contains a smaller percentage of protein. The protein of barley, however, is sufficient in amount and is much superior in quality to the protein of corn and beans.

Barley thrives in a greater diversity of climates than any other cereal. It flourishes at the equator and grows equally well in the arctic climate of northern Russia. Barley is a staple food in Siberia and among many of the tribes of Central Asia.

Hindhede, the eminent physiologist of Copenhagen, conducted a series of investigations to determine the practical food value of barley and concludes that this cereal "Is too valuable as a human food to be used in these hard times (during the war) as a fodder for pigs and in the production of beer." In Hindhede's feeding experiments the diet of his subjects consisted exclusively of barley, margarine, milk and fruit. The results showed most conclusively its ability to largely replace other grains as a cereal food.

Its chief drawback is the fact that to most people it is less palatable than wheat. The bread made from barley is much inferior to that which may be made from rye or wheat, and it accordingly falls into disuse in countries where these grains can be grown. Fairly good bread can be made from it by the addition of a proportion of wheat flour.

Pearl Barley.

Barley is little used in this country as a food grain except in the form of pearl barley, which is frequently used as an invalid dish. In the process of pearling the tough outer coat of the grain is removed.

RYE

Rye contains a certain proportion of gluten and is capable of being made into a nutritious bread, the pumpernickel of the Germans, a sour dough bread in which the whole grain is represented. Although coarse, and to the American palate rather unpalatable, this black bread is nevertheless far more wholesome than the superfine white bread in general use, not only because of its marked laxative properties but because of the large proportion of lime and iron, together with a rich store of vitamins which it contains.

MILLET

Although largely used throughout Asia and in some parts of Africa, millet is little known as a food cereal in either the United States or Europe. Its composition is very similar to that of barley. It contains nearly twice as much cellulose as does wheat. Recent experiments by Osborne and Mendel indicate that millet contains a richer store of vitamins than any other of the cereals. It is indeed, the only cereal which is able to support animal life and development for a considerable length of time when used as an exclusive dietary. It is probable that this cereal will ultimately fill a more important place in the world's bill of fare than it does at the present time. Mixed with a proportion of wheat flour, millet flour, especially a flour prepared from proso millet, is said to make a fairly good bread.

QUINOA

Quinoa, a cultivated pigweed, was a staple food of the natives of Mexico and South America before the conquest of these regions by Cortez. It is said to have produced prodigious crops. The seed is rich in protein, of which the flour contains 19 per cent. with 60 per cent. of starch and 5 per cent. of fat. The amount of cellulose contained in the whole seed is greater than that of any other food cereal.

A Scotchman resident in Peru, where quinoa is still much used, declares it to be preferable to oatmeal as a breakfast food.

KAOLING

The sorghum grain, long used in India and Northern Africa, known for more than 50 years in this country, but thus far little used, is worthy of more attention than it has heretofore received.

BUCKWHEAT

Flour prepared from buckwheat is chiefly used for griddle cakes. When well prepared and made without contamination by burned fat, the griddle cake is not unwholesome; but as ordinarily prepared, buckwheat cakes are highly productive of indigestion. Buckwheat contains more carbohydrate than most other cereals, nearly 78 per cent., with a protein content of 6.4 per cent.

BREAKFAST CEREALS

The manufacture of breakfast cereals in the United States really originated with the late Ferd. Shoemaker of Akron, Ohio. Mr. Shoemaker told the writer that as an apprentice in a pharmacy in Hamburg, Germany, when a boy, one of his duties was to prepare the oatmeal. This was done by hulling the grain by putting it through a set of millstones made for the purpose and turned by hand, then reversing the stones and putting the grain through a second time to convert it into grits. On coming to this country he found that the oatmeal in use here was imported and sold only in small packages in drug stores for use by invalids. He set to work to devise means for manufacturing oatmeal on a commercial scale. From a small beginning, he gradually developed a great industry, and by carrying on a vigorous educational campaign, developed a demand for oatmeal which finally grew so great as to make the grain a food staple.

Ready-to-Eat Breakfast Foods.

Carlsbad, the famous Bohemian watering place, has for a century or more owed its popularity in part, at least, to the zwieback (provincial German for twice baked) of which visitors to the resort were expected to make liberal use as a part of the cure. From Carlsbad the use of zwieback, which is simply well toasted bread, was introduced into this country through the water cures, which at a certain period beginning more than a hundred years ago, enjoyed a considerable degree of popularity. The zwieback was sometimes ground to render it more easily eatable but neither zwieback nor "rusk" were commercially obtainable in this country.

When a medical student in New York City in 1874-5, after having made a special study of foods for two or three years, the writer became convinced that there existed a widespread need for ready-cooked foods, at least, ready-to-eat cereals. A year or two later, after becoming superintendent of the Battle Creek Sanitarium, the idea became concrete in the production of Granola, which consisted of a mixture of oatmeal, corn meal and wheat meal made into cakes with water and exposed to a temperature sufficient to dextrinize the starch, with the idea of thus rendering it more readily digestible. The product was ground to give it a granular form convenient to eat with milk, cream or fruit juices.

This product became the forerunner of several other similar products in which the idea of dextrinizing the starch content of cereals was developed in various ways. This was considered important for the reason that certain forms of indigestion were found to be relieved by the use of dextrinized foods. The reason was not then wholly clear, although it was observed that digestion was aided by the pre-digestion of starch. We now know that undigested cooked starch absorbs the pepsin of the gastric juice, leaving the gastric acid "free," and thus giving rise to "acidity." Pavlov also showed that dextrin is strongly peptogenic, that is, acts as a natural gastric stimulant.

Toasted Cereal Flakes.

The writer early in his medical experience became convinced that indigestion and decay of the teeth were encouraged to a marked degree by failure to use the teeth sufficiently in the thorough mastication of the food. He accordingly made it a practice to require his patients to begin each meal by chewing slowly a small slice of dry zwieback. One day a patient came into the office with a complaint that our prescription had broken her teeth, for which she jokingly demanded compensation. The impracticability of zwieback as a dry food in several classes of patients was at once apparent. Patients with artificial teeth, with sore teeth or diseased gums, and patients without teeth, needed something which they could chew and comminute without running the risk of injury to their teeth or other inconvenience. Experiments were begun to produce toasted or dextrinized cereals in a form which, while dry and crisp, could be properly offered to such persons and eaten by them without the addition of milk or cream, which would destroy their value as a dry food capable of stimulating an abundant flow of saliva, experiments made about the same time by the writer having demonstrated dryness to be one of the most efficient means of stimulating the activity of the salivary glands.

After some months of experimentation, the writer developed the process for making toasted cereal flakes which is now widely used in the manufacture of toasted corn flakes, toasted rice flakes, wheat flakes, etc. The first flakes made were wheat flakes and were known as Granose, and later as Toasted Wheat Flakes. Various imitations were known as Malta Vita, Force, Vim, Egg-O-See, Tryabita, etc. Later, toasted rice flakes, and other cereal flakes were developed by the writer.

The writer has been glad to see that these dextrinized products have been so generally adopted as components of the American breakfast. Of the score or more different brands of these flake cereals now on the market, probably not less than 30 or 40 carloads are used daily by the people of the United States alone, and their use is gradually extending to every other civilized country of the globe. The only objection that can be offered to these dextrinized cereals is the fact that they are deficient in cellulose, vitamins, iron and lime. Vitamins and lime are, however, added in the milk with which they are served, and the addition of a tablespoonful of bran to the morning dish is a most convenient method of making use of this important laxative element which, through the pernicious ingenuity of the American miller, has been until recently almost altogether excluded from the national bill of fare. The bran supplies iron but not enough. Spinach or other greens should be made a part of the daily menu when corn or rice is freely used.

The argument offered by some critics that malted and dextrinized foodstuffs weaken the stomach by lessening the work required of it, though theoretically plausible, is not conclusive. There is a physiologic antagonism between the salivary digestion of starch, which takes place first in the mouth and later in the stomach, and the gastric digestion proper, which is carried on by the acid gastric juice. The more gastric juice in the stomach, the more active gastric digestion, the sooner the action of the saliva upon the starch ceases after the food enters the stomach; and on the other hand, the less complete the digestion of the starch, the more gastric digestion is interfered with through the absorption of pepsin by the undigested starch, already referred to, and also through the incomplete disintegration of the food, a process which is greatly facilitated by the action of the saliva, rendering the starch soluble. When the food is dextrinized, the digestion of starch being more complete, does not interfere with gastric digestion but, on the other hand, stimulates the gastric glands to greater activity and so promotes the work of the stomach instead of hindering it.

The writer thinks it important to add, however, that he would by no means advocate exclusive use of predigested foods or of predigested starch for the reason that it is desirable to send down into the colon daily a certain amount of undigested starch to serve as nutrient material for the protective germs which discourage putrefaction and encourage bowel action by the production of acids through fermentation. Raw starch is better for this purpose than cooked.

SESAME SEED MEAL

This oleaginous seed is much used in India and the Orient, as well as in all parts of Africa. Dr. Thompson thus describes this valuable plant and its preparation:

The plant grows "to a height of three to six feet, giving off blossoms at the beginning of each stalk or branch. The seed pod is about an inch in length, a quarter of an inch in diameter, and has four cells running lengthwise of the pod, which contain the seed. The plant is raised in connection with millet in the gardens of the natives. The name is *Sesamum Indicum.* It is grown a good deal in India.

"When the seed is ripe, the natives cut the plant off near the ground, tie it in bundles, and stand the bundles up where they can get perfectly dry. A cloth is then spread on the ground and the bundles are beaten with sticks to rattle the seeds out. The seed is moistened with warm water and rubbed between the hands to remove the outer hull. The seed is commonly black in color, but some varieties are nearly white. The seed is next roasted, which is the most particular part of the process. A little salt is added and the seed is ground between two stones as the natives grind their other grains."

The writer witnessed the process described in operation on quite an extensive scale in Cairo, Egypt, some twenty years ago. The ground, roasted seed was used as a meal and also in the form of a paste or butter much resembling the peanut butter now in general use in this country.

Vegetables

Vegetables are chiefly useful because of the carbohydrates which they furnish, together with an abundance of the alkaline salts, vitamins, and cellulose. Only one class of vegetables, the legumes, is rich in protein. A comparatively few vegetables contain carbohydrates in large quantities. For the most part, vegetables, especially green vegetables, contain a large amount of water.

The carbohydrates of vegetables, when abundant, usually exist in the form of starch which possesses the property of being more easily digestible than starch from any other source. Certain vegetables are rich in sugar, which is, for the most part, in the form of cane sugar, the sugar of roots, stems, and leaves.

Uncooked Vegetables.

Green vegetables, such as lettuce, parsley and other salad vegetables, may be eaten without cooking and may be advantageously utilized in this way because of the value of the vitamins which they contain, some of which are wholly or in part destroyed by cooking.

It is hardly possible to overemphasize the importance of taking a portion of the food in uncooked form. The primitive ancestors of the human race subsisted wholly upon the natural products of the forest, as do a few wild tribes even at the present day. As an exclusive diet, uncooked food must be selected with the greatest care; and such a diet is hardly possible without the addition of milk, eggs or meat, at least, for long periods.

The best foods for use in uncooked form are lettuce, celery, green salads, Chinese cabbage, radishes, turnips and green sweet corn. Wheat, in the milk state, may be used in like manner. The turnip, and even the carrot, properly prepared may be utilized in the absence of other more suitable raw foods. Recent experiments by Langworthy have shown that raw potato starch is almost wholly indigestible, although cooked potato starch digests more quickly than any other form of starch known. The starch of the unripe banana, like that of the potato, appears to be unusually difficult of digestion. The starch of raw cereals, on the other hand, has been shown to be quite readily digestible.

Roots and Tubers.

Most plants store up in the seed a supply of nutriment to be utilized in starting the growth of the new plantlet. The plant gathers its nourishment through its roots and leaves. The leaves constitute both the lungs and the stomach of the plant. These organs must be provided before the plant can begin an independent existence. Certain plants, because of peculiar habits, provide an additional store of nourishment in fleshy, succulent roots, as in the beet, turnip, parsnip, and carrot; or in fleshy underground stems, as in the potato, the sweet potato, the yam, the taro, dasheen and yautia.

Root Starches.

The idea that root vegetables, particularly starchy roots such as the potato, are inferior foodstuffs and indigestible, is a serious error which somehow has attained wide currency. The fact is that root starches when cooked are by far the most easily digestible of all foodstuffs.

Some years ago, Professor Grierson, an eminent German physiologist, made a careful study of the digestibility of starches from various sources. He found that the starch of rice, wheat and corn require two hours for digestion; the starch of oatmeal, eighty minutes; while arrowroot digests in thirty minutes and potato starch is completely digested in ten minutes. In other words, the starch of wheat, corn and rice requires twelve times as long for digestion as does the starch of potatoes, and the starch of oatmeal, eight times as long.

No doubt the substitution of cereal breakfast foods for the old-time griddle cakes, fried potatoes, fried pork and other indigestibles, has been in the interest of the conservation of the American stomach, but there is much reason to believe that the Irish potato, steamed or baked, might well fill a larger place in the national bill of fare, especially as a breakfast food.

A baked potato digests in much less than half the time required for the digestion of a slice of bread and affords nutritive substances in some respects superior to those provided by wheat. The housewife adds potato to her bread sponge because it encourages the growth of the yeast plant and so makes the bread rise better. The growth-promoting vitamin which the potato supplies in great abundance, is as active in encouraging the growth of children as in helping bread to rise. It is equally useful to adults in maintaining good nutrition and by promoting the repair of the tissues.

The potato and other root vegetables are also superior to cereals in the fact that they supply an abundance of organic alkalies, compounds of soda and potash, which are of the greatest service in neutralizing the acid wastes of the body and promoting the purification of the tissues.

The sedentary habits and the free use of meat and cereals in the diet of the average American, produce a widespread tendency to acidosis, which is a common cause of premature senility, hardening of the arteries, Bright's disease and other degenerative processses. If the average American would eat four or five times as much potatoes as he now eats, and an equivalent amount less of cereals and cane sugar, the result would be a notable lowering of the death rate and a marked increase in physical fitness and freedom from crippling disease.

The Iron Content of Vegetables.

Vegetables are like fruits in their small average content of iron per ounce (1.46 per cent of ration), but relatively large content per 100 calories. In this respect they are even more remarkable than fruits. Vegetables are also like fruits in the fact that their small nutrient value renders possible a bulky intake, so that in practical use fresh vegetables become a highly important source of food iron. The average iron ration percentage value for nineteen common vegetables is 10.4 per 100 calories.

The vegetable which provides the most iron in an ordinary serving is the potato, which in a small serving of three ounces provides one-twelfth of a day's requirement. The Irish farmer, who daily eats several pounds of potatoes, evidently gets a full supply of iron, notwithstanding the fact that his chief article of food aside from the potato is buttermilk, which contains very little iron. The Scotch Highlander finds an equally fortunate food combination in buttermilk, supplemented by oatmeal "brose" "bannocks" and "scones."

Brussels sprouts and cabbage each furnish in a 3 ounce serving one-tenth of a day's supply of iron; and string beans, carrots, and turnips provide in a small serving, which in many cases might easily be doubled, more than half as much iron as a serving of potatoes.

The vegetables which contain so small an amount of iron as to be of comparatively little value as sources of food iron, named in the order of their inferiority are, beginning with the cucumber which contains least of any of the common vegetables, eggplant, turnip, and sweet potato. The last named vegetable contains less than half as much iron as the Irish potato.

Onions have a special claim to notice because of the high value of the iron compound which they supply which, according to Stokless, contains more iron even than the hematogen of egg yolk, discovered by Bunge, and is equally well utilized by the body. So, at last, this often rejected, and by many much despised, vegetable is likely to be accorded a more honorable place in the list of choice comestibles than it has heretofore enjoyed. It must not be forgotten, however, that not a little culinary skill is required to eliminate the offensive essential oil of the onion which is by no means its chief attraction, although it's most conspicuous feature. A peculiar saccharine substance which reveals itself only after the rank, blistering aromatic oil has been driven away by heat, gives to the onion its valuable flavoring quality.

The Lime Content of Vegetables.

In studying vegetables with reference to their lime content, one is struck by the fact that among a dozen commonly used vegetables, omitting "greens" there is not a single one in which the lime salts are largely represented. The average lime content is one-tenth grain to the ounce, almost the same as that of cereals. Lime is found, however, in notable quantities in certain vegetables.

Parsnips, onions, string beans and Kohl-rabi are comparatively rich in lime, supplying in an ordinary serving, respectively, 7.7, 3-4, 3.0 and 12.2 per cents. of the total day's needs.

Because of their bulky nature vegetables may be eaten in much larger quantity than the concentrated cereals, and so a liberal intake of lime may be made in eating vegetables in which the percentage of lime is comparatively small. The turnip, for example, contains less than .4 of a grain of lime to the ounce, but an ordinary serving is 4.5 ounces, which supplies more than one-tenth (11.4 per cent) of a day's lime ration.

Hence nearly all the vegetables may supply a considerable amount of food lime, when in their natural state, or when cooked by steam or oven heat; but if boiled, when removed from the water in which they have been boiled they leave behind a large part of their content of lime and other food salts. Vegetables should always be steamed or baked rather than boiled, so as to preserve the so-called inorganic elements, which are as essential to animal and human life as to the lives of plants.

Of all the vegetables, the eggplant contains the least lime, so little in fact as to be hardly worth noting. The amount found in an ordinary liberal serving is only one-tenth of a grain. Next in order of deficiency is our most commonly used vegetable, the Irish potato which presents a lime content of only one-twelfth of a grain (.086 grs.) to the ounce, requiring the impractical amount of 11 pounds for a full lime ration. It is well to note just here, however, that the potato is rich in iron.

The sweet potato contains a little more lime than the Irish potato but is still very deficient in this essential element. Evidently the potato cannot be safely used as a staple without supplementing it by other foodstuffs, which are rich in lime. Prof. Hindhede, who has devoted his life to food research and with most extraordinary benefit to his country and the whole civilized world, has shown that human life and energy may be well sustained for an indefinite time on a potato diet. A private letter recently received from Professor Hindhede by the writer states that in his potato-feeding experiments then still in progress he found it necessary to add to the potato liberal quantities of greens. The greens supply not only a sufficient amount of lime, but also the essential fat-soluble vitamin which the potato lacks.

THE WHITE POTATO

One of the most important discoveries made by Sir Walter Raleigh was the white potato, which he found on Roanoke Island, from which he sent to England in 1586 the first cargo of this valuable vegetable. Next to the cereals the potato is the most important food staple raised in this country. In certain European countries it holds a much larger place in the national dietary than in this country.

When first introduced in Europe, the potato met with great opposition. It was accused of being the cause of leprosy. In more recent years, the potato has been suspected of being the cause of indigestion and of rheumatism. All of these objections are equally unfounded. The potato is one of the most digestible of foods, and has a much higher nutritive value than is generally supposed, a single ounce affording more than twenty-four calories of nutrient material, or one-third as much as an equal weight of bread. Its chief food principle is starch, but it contains also a notable amount of protein which is of exceptionally high value. It has, indeed, been demonstrated by Hindhede in a very extended research, that the potato is capable of serving as an exclusive source of protein. Hindhede's subject, a young man, lived on potato and margarine as an exclusive diet for three hundred and nine days, and during this time did heavy work.

A second research was undertaken by Miss Lenna F. Cooper, in the laboratory of Columbia University. This study showed the protein of the potato to possess a high nutritive value, and fully capable of meeting the protein requirements of the body when taken in the quantity of about three pounds daily by a person weighing one hundred and ten pounds. The only other articles of food eaten were butter and sugar, the latter in very small quantities, and the total value of the daily food intake was 2000 calories.

It is evident, then, that even with a dietary of which the potato forms a very substantial part, there need be no apprehension of a deficiency of protein.

The potato is rich in soda and potash, salts which make it valuable as a means of combating a tendency to acidosis. It would doubtless be well for the American people if they would substitute potatoes for a considerable proportion of the cereal breakfast foods which they now eat. The excess of acids contained in cereals, and especially the great excess of acids found in meats of all sorts, tend to encourage the development of arteriosclerosis, or hardening of the arteries, and premature old age.

The alkaline salts are found in greater abundance in the potato than any other staple vegetable food. The potato furnishes forty times as much of these alkaline elements as do some of the cereals. Human beings require the potato and other green vegetables to furnish these salts for the same reason that the animal requires grass.

The potato is, however, lacking in lime, and also iron, and for this reason should be supplemented by spinach or other greens.

Another quality of the potato which renders it of inestimable value as a human food is the fact that it is rich in antiscorbutic and antineuritic vitamins.

After the potato was introduced and became generally used in Europe, the great epidemics of scurvy which had previously prevailed, ceased to appear. Potato soup or porridge should be used with bottle-fed infants when sterilized milk is employed and orange juice is not obtainable. A larger use of the potato would be of immense profit to the American people.

Since Count Rumford (Benjamin Thompson, a New England Yankee,) taught the Bavarians how to make potato soup, this vegetable has steadily increased in popularity in Germany, where it holds a large place in the national bill of fare.

The peasantry of Ireland afford, also, a good example of the high nutritive value of the potato which, with the addition of buttermilk and oatmeal, has shown its ability to develop a vigorous and long-lived race.

The poor keeping qualities of the potato is one of the drawbacks to its greater use as a nutrient. The new methods of dehydration promise, however, to overcome this difficulty in this country, as they have in Germany, where many thousands of tons of potatoes are annually preserved by drying for the feeding of both human beings and domestic animals. Dried potatoes seem to have all the value of the fresh vegetables except in one particular; the process of drying appears to impair the value of the vitamins, particularly the antiscorbutic vitamin.

Potato Poisoning.

An outbreak of potato poisoning occurred in Glasgow in 1917 which was traced to sprouted potatoes. Such potatoes contain 5 or 6 times as much solanin as unsprouted potatoes and are unfit for food.

Several cases of poisoning from potatoes have occurred in which the potatoes became contaminated after having been scrubbed and pared, by being left to stand exposed amid unsanitary conditions. The potato affords an excellent culture medium for various forms of dangerous bacteria.

Potato Cookery.

The manner of cooking the potato is a matter of much importance. If peeled and soaked in cold water for some hours before cooking, 25 per cent of the protein and a large share of its salts are dissolved by the cooking water and wasted if the water is thrown away. This method is most suitable for preparing soups when the water is used, but is otherwise most wasteful. If peeled potatoes are plunged into cold water and brought at once to the boiling point, the loss is about two-thirds as great. If the peeled potato is plunged directly into boiling water the loss is still further reduced about one-third. When boiled without peeling, the loss of protein is very small, only about one per cent, and the loss of mineral matter about three per cent. When boiled in this way the potato should be removed at once from the water when done. By drainage and evaporation a sufficient amount of water is removed to render them dry and "mealy;" whereas if allowed to remain in the water they become soggy. Mealiness is due, not to the swelling of the starch grains, as is generally supposed, but to the separation of the cells in cooking under the influence of heat and moisture which softens and dissolves the cellulose framework.

The best method of cooking the potato is by baking. As soon as sufficiently baked, they should be removed from the oven and their jackets should be broken by squeezing so as to allow the steam to escape.

It has been experimentally proved that 5½ ozs. of potatoes will pass through the stomach in 2½ hours. Mealy potatoes digest in less time than waxy ones, and mashed potatoes, sooner than unmashed.

The question is often asked, "Should potato skins be eaten?" The skin of the potato is good roughage, but the popular notion that the potato skin contains important nutritive material, especially vitamins, is erroneous. Experiments made with animals show that potato skins have no protective action against scurvy. This is true of boiled and steamed potatoes as well as of baked potatoes. Any antiscorbutic properties which the potato skin may possess in the raw state are destroyed by cooking.

THE SWEET POTATO

While somewhat more nutritious than the Irish potato, the sweet potato, on account of its more pronounced flavor, is not so universally liked. It grows best in warm countries and its use is chiefly confined to the Southern states and semi-tropical countries. It is subject to different kinds of rots and does not keep as well as the Irish potato. The sweet potato contains 25 to 30 per cent. of carbohydrates, of which about two-thirds is starch. The balance is chiefly cane sugar, of which some varieties contain as much as 10 per cent. It would be more largely used if it had better keeping qualities. The Southern varieties are sweeter and keep better than Jersey sweet potatoes. It is probable that drying processes will soon be employed as a means of preserving this valuable vegetable.

THE DASHEEN

The dasheen is a highly valuable tuber which has been introduced into this country from South America by the U. S. Department of Agriculture. It is botanically allied to the elephant ear and the dahlia, the tubers of which are also edible. The dasheen is richer in starch and protein than is the potato. When properly cooked it is highly palatable, and being exceedingly prolific and growing in soil not adapted to either white or sweet potatoes, it may be regarded as a valuable addition to our list of foodstuffs. Like the sweet potato, the dasheen requires great care in keeping. It is not likely to take the place of the potato, but is a palatable and wholesome esculent and is perhaps the most easily digestible of all the tubers grown in this country, closely resembling in this particular the celebrated taro.

THE TARO

The taro is a tropical tuber much used in the Hawaiian Islands and certain parts of India, China, and Japan. It resembles the sweet potato in appearance, and has about the same nutritive value. It is eaten by the Hawaiians as poi, a sticky, doughy mass which is allowed to ferment before using. Attempts have been made to introduce the dried taro in the form of flour into this country as a substitute for other farinaceous foods, especially for use by invalids. It is less palatable than corn starch, but as a nutrient is doubtless superior.

THE CASSAVA

This is a tuberous root which grows from 10 to 12 inches in length, often 3 to 4 inches in thickness and in clusters of 4 to 8. This vegetable is little known in the United States but is much used in Cuba and other portions of tropical America. It is now grown to a limited extent and used in Florida, especially in the vicinity of Tampa, chiefly by Cubans who have recently come to this country in great numbers in connection with the cigar business.

According to Turner, the native tribes of Africa prepare a poisonous species of the cassava for food by the following primitive method:—

"The fresh root is rubbed through a perforated grater or more commonly is scraped with a snail's shell into a coarse powder; this is dried in the sun, is afterwards placed in a kaffir pot over the fire and continually stirred during the roasting, in the way that coffee beans are treated. This process dispels all hydrocyanic acid. After roasting in this manner it can be stored, and will remain good for a long time—one to two years."

When properly prepared the cassava is a very palatable and highly nutritious vegetable. Its use in this country should be encouraged.

Cassava bread is prepared from the kassabi root which grows everywhere in tropical South America, Central America and the West Indies. Bread prepared from the kassabi root is a sort of hardtack with a slight potato flavor. It is prepared without yeast, salt or shortening. It is slightly laxative and is largely used in preference to other breads on that account. Cassava bread is said to be the oldest form of bread used on the American continent, the tortilla prepared from corn being a later invention. It is the food of millions of people in South America and is to a small extent imported to this country and is nearly always obtainable in certain stores in New York.

THE YAUTIA

This is a tuber which resembles the taro, native to the West Indies and largely grown in Porto Rico. It is prepared for the table in the same manner as yams or sweet potatoes. As served in the native hotels of Porto Rico the writer found this vegetable quite insipid and by no means equal to the potato.

THE ONION

The principal bulb used as food in this country is the onion, of which there are more than 70 varieties. The characteristic flavor of the onion is due to an oil containing allyl sulphid, which is excreted through the lungs when this vegetable is eaten, giving the breath a characteristic odor.

The onion also contains a peculiar form of sugar to which the sweet flavor of roasted onions is due. The onion is much used as a food in Egypt where it is soft and sweet, in strong contrast with the hard pungent product of other lands. Herodotus tells us that nine tons of gold were spent in the purchase of onions for the workmen who built the pyramids.

The white onion is preferable to the red and yellow varieties, having a milder flavor. Young onions are better than mature ones for the same reason. The best method of cooking the onion is by roasting in the ashes or in a very hot oven. When roasted in the oven they may be buried in sand. When prepared in this way, the high temperature to which they are subjected volatilizes the greater part of the essential oil to which the odor is due and thus removes one of the chief objections to the use of this vegetable. A fact not generally known which is worthy of note is that the onion affords a very excellent form of food iron, and on this account may often be eaten freely with advantage by persons suffering from anemia.

A very sweet onion, closely resembling the Egyptian variety is now grown in the Coachella valley of California.

THE GARLIC

A member of the onion family much used in Oriental and other tropical countries. Notwithstanding the general prejudice against this vegetable on account of the disagreeable character of its odor when present in excess, it must nevertheless be admitted that when properly used it does increase the palatability of certain salads, soups and other dishes, and a liking for it may be easily cultivated.

THE LEEK

A relative of the onion much used as a flavor by the Scotch and in some parts of England. It was an ingredient of the famous cock-a-leekie soup described by Sir Walter Scott and of the "Herby" pie of Cornwall, which according to Sir Charles Kingsley "diffuses through the ambient air a delicate odor of mingled guano and polecat." This highly aromatic vegetable has never found favor in this country, but is perhaps worthy of greater consideration.

LILY BULBS

The Chinese and some other Orientals make considerable use of the lily bulb, which is boiled or roasted and eaten with sugar or sirup. It is a wholesome food, free from sugar and starch and is beginning to be used in this country, especially by diabetics.

THE WATER CHESTNUT

The water chestnut is a tuber which grows in damp or swampy ground. It is small, irregularly shaped and covered with a brown skin. It has a white, brittle flesh which much resembles the chestnut in flavor.

Green Vegetables

This class of food products contains a smaller amount of nutrient material than any other; nevertheless vegetables are essential to a biologic diet because of the valuable salts, cellulose, and vitamins which they contain. They are nearly always spoiled in the cooking. When cooked in hard water the nutritive material is hardened and its digestibility diminished by the lime and magnesia salts of the water.

Analysis of the water used in boiling vegetables shows that it contains a large part of the nutritive salts and vitamins they are able to furnish. On this account vegetables should be steamed or baked rather than boiled, or if boiled, the water in which they are cooked should be utilized in soups or porridge so that the important nutritive principles which they contain shall not be lost. Fresh vegetables should be used much more freely than is customary in this country.

THE CABBAGE

At the head of the list of green vegetables should be placed the cabbage, which has been used from the most ancient times. The cabbage was the Emperor Pompey's favorite dish. This garden vegetable is chiefly valuable for the stores of lime and alkaline salts which it contains, together with a considerable amount of the valuable antiscorbutic vitamin. These constituents are largely lost in boiling, however, so the vegetable should be eaten either raw or steamed. The Scotch save the water in which cabbage has been cooked and cook oatmeal in it, a dish which they call "kale brose," a wise economy.

Cabbage may be eaten raw by many persons who are unable to eat cooked cabbage; in fact, raw cabbage is often tolerated by persons whose digestion is considered very delicate. When properly chewed, this excellent vegetable is very little likely to disagree. Some years ago the writer conducted a research for the purpose of determining the reason for this difference between raw and cooked cabbage. One experiment consisted in the inoculation of equal quantities of raw cabbage and cooked cabbage with a definite amount of colon germs. Later, examination showed that while the bacteria had greatly multiplied in the cooked cabbage they had actually diminished in number in the raw cabbage. The greater readiness with which cooked cabbage undergoes bacterial changes in the intestine may be the cause of the disturbance noticed in some persons.

Sauerkraut.

This is a preparation of chopped cabbage which has been permitted to undergo lactic acid fermentation. Sauerkraut serves the same purpose for the peasantry of Eastern Europe and Western Asia that is served by the silo of the modern dairy farm, in which greenstuffs of various sorts are preserved by being made to undergo lactic acid fermentation. Sauerkraut supplies the Russian peasant with food lime and food iron during the long winter months when fresh vegetables are not obtainable. Sauerkraut is little used in this country except by foreigners, but it deserves a larger place in the national bill of fare.

The cabbage is a valuable source of iron, vegetable salts, and vitamins. In addition, it is a valuable means of giving the alimentary mass the necessary bulk to encourage peristaltic action.

When properly made sauerkraut is a most wholesome foodstuff. The following is a well tested method:—

Select mature cabbage. Remove green and wilted leaves, also remove the core of the cabbage. Shred quite fine. Place a layer two inches thick in a small crock and pound until juice appears, then put into a larger crock or the permanent retainer. Add salt in the proportion of two ounces for each five pounds of cabbage, sprinkling in evenly as each layer is added.

When the crock is full, place a clean cloth over the top of the cabbage, then over this press down a clean board of such size that it will fit inside the crock rather loosely. Put one or more stones upon the cover. The weight should be sufficient to cause the juice to cover the cabbage within a few days.

Set the container aside in a room of ordinary temperature to ferment. When scum forms upon the surface, remove it. The scum consists of a micro-organism which if permitted to remain, will destroy the acid and cause decay of the cabbage. It is this that often develops a bad flavor and odor in sauerkraut.

The process of fermentation is shown by the rising of bubbles to the surface of the liquid. When the bubbling ceases, fermentation is completed, which will be at the end of eight or ten days in a warm room; in a cold room, two to four weeks.

In examining with reference to fermentation, tap the side of the container to loosen the bubbles adhering to the inner surface.

When the fermentation is finished, that is, when bubbles cease to rise, skim carefully and pour on melted paraffin wax to the depth of a quarter of an inch. The paraffin should be hot enough to cause the brine to boil as it is poured on. The layer of paraffin should be sufficiently thick to tightly seal the container and should not be disturbed until the sauerkraut is to be used. Paraffin is not necessary if a very cold place is available for storage.

Composition of Sauerkraut.

A reliable German authority gives the following as the chemical composition of sauerkraut:—

	Per Cent.
Water	89.00
Protein	1.60
Fat	.35
Lactic acid	1.50
Dextrose	.65
Mannose	1.00
Crude fiber	1.00
Ash	2.90
Sodium chloride (common salt)	2.00

BRUSSELS SPROUTS

A curious member of the cabbage family in which instead of one large head the plant bears many small heads. Brussels sprouts may be regarded as superior to ordinary cabbage on account of the larger amount of food iron present, as indicated by the green color due to chlorophyl.

CAULIFLOWER

Another remarkable member of the cabbage family of which the flower is the edible part. Its chief value is in the salts and vitamins which it supplies.

BROCCOLI SPROUTS

A variety of the cabbage, the leaves of which are used as food. It is rich in salts and vitamins.

SEAKALE

A fresh vegetable which is chiefly valuable for its young and delicate shoots. It is much used in Great Britain where it is found growing wild near the seashore. Kale is easily digestible though very low in food value, furnishing only 175 calories to the pound. It is less valuable as a source of salts than are the cabbage and the cauliflower.

THE PAI TS'AI OR CHINESE CABBAGE

The pai ts'ai (pronounced pi-tsi) is a relative of the turnip. It forms a cylindrical, rather loose head with greenish outer leaves and a white, very tender and pleasantly flavored heart. It matures best in autumn and should be sown in midsummer in rich friable soil and must be well watered and kept growing steadily. Use like cabbage.

The composition of the fresh raw cabbage is as follows: Protein, 1.2; Sugar, 1.4; Fiber, .5; Ash, .5; Water, 96.4.

After extraction by thrice boiling, the composition is: Protein, 1.07; Sugar, .05; Fiber, 1.16; Ash, .24; Water, 95.30.

PALM CABBAGE

The terminal bud of several varieties of palms is a very toothsome vegetable which somewhat resembles cabbage in texture and has, when raw, a delicious flavor suggesting that of the chestnut, and when cooked, a delicate meaty flavor. Xenophon mentions palm cabbage as being a favorite among the young Greeks, who he says, greatly enjoyed the "brain" of the palm as well as its luscious dates.

The palm cabbage contains a very small amount of carbohydrates and is suited for use by diabetic patients, for whose benefit the millions of cabbage palms growing in the swamps of Florida ought to be utilized. This vegetable, canned and sold under the name, "The Heart of the Palm," may be obtained from certain dealers in delicatessen who get their supply from "Union," a group of islands of the South Pacific.

CELERY

This vegetable is usually eaten raw. Its nutritive value is very low, only about five calories to the ounce, but it is rich in vitamins, as has been proven by McCollum in feeding experiments. It is also rich in food salts. Its flavor is appetizing and its free use is to be commended. It may be eaten cooked.

LETTUCE

The lettuce is a very old-fashioned plant. Its mildly flavored, juicy leaves have made it a great favorite from the most ancient times.

Augustus Ceasar was very fond of lettuce and attributed to its use his recovery from a serious illness. It is said that he afterward held this plant in such high esteem that he erected a statue and dedicated an altar to it.

In the time of Domitian, the Romans served lettuce with eggs, as we do at the present time—probably one of the most ancient of eating customs. It was served with the last course, so as to stimulate the jaded appetites of the feasters.

It is strange that this estimable plant did not reach the Western world until the time of Queen Elizabeth, when it was first grown in England.

The lettuce furnishes valuable salts and vitamins and supplies bulk to aid bowel action. It is especially to be recommended to those who have a tendency to over-fatness. It should be used by such persons very freely, and with lemon juice only, oil being avoided. A large plateful should be eaten at the beginning of every meal.

The cabbage and the lettuce while valuable are not to be compared with "greens" in their vitamin content. They are also inferior as sources of food iron and lime.

ASPARAGUS

A highly toothsome green vegetable, valuable for its salts and vitamins, as well as for the large amount of cellulose which it contains.

Recent analyses of asparagus show that the raw vegetable contains 10 per cent. of solids, of which 70 per cent. is soluble in cold water and 80 per cent. in boiling water. The composition is as follows:—

	Per Cent.
Water	90.
Sugar	3.6
Protein	3.8
Fiber	1.
Fat	.5
Mineral matter	.8

Green asparagus contains less fiber than white and yields more soluble matter when boiled. The asparagus tip is especially rich in vitamins.

Asparagus is botanically related to the onion. If the tender shoots are left in water a few days a marked onion odor develops. An oil may be extracted from raw asparagus shoots which contains sulphur, and it is to this that is due the peculiar odor observed in the urine after eating asparagus.

It is evident that asparagus should be steamed rather than boiled. After boiling for a few minutes the amount of nutritive material left is too small to be of any real value, at least four-fifths of all the nutrients having been dissolved by the boiling water.

ENDIVE—WHITE CHICORY

The blanched leaves are the edible part. It is fairly rich in salts but of little nutritive value.

OKRA

The edible part is the large unripe seed pod, which contains a large amount of pectose which jellies when the pods are cooked in water, on account of which it is largely used in preparing a dish called gumbo. The pods may be boiled and eaten like asparagus.

THE ARTICHOKE

This plant is a variety of thistle of which the undeveloped flower buds are cooked and eaten. The plant is said to contain inulin instead of starch, on which account it is recommended as a food for diabetics.

ICELAND MOSS

Iceland moss is a lichen which grows in the Arctic regions. It is much used by the Laplanders. It contains no starch, and whatever food value it has is doubtless due to the cellulose and vitamins which it contains. Reindeer moss is also a lichen.

The lichen is a curious partnership between an alga and a fungus. The alga forms food, which the fungus cannot do, and the thread like fungus which entwines the alga, supplies water; thus these two distinct species of plants thrive in partnership although neither is able to live alone.

The use of the lichen as a food for human beings has been known from the most ancient times. According to A. A. Hansen, "it has been almost definitely demonstrated that the manna which was such a boon to the children of Israel was the manna lichen, *lecanora esculenta*. During certain seasons of the year, this plant dries and hardens, forming warty grains which fall in showers from the mountain sides into the valleys. These are used as food in Algeria, Southwest Asia and the Steppe region. The grains form an acceptable substitute for corn."

Iceland moss is used in northern regions for bread. After soaking in water to remove a bitter principle, the moss is dried and ground to a fine flour which is mixed with an equal amount of wheat flour and made into loaves of an excellent bread.

Reindeer moss has been used in Sweden in like manner for bread making. This remarkable lichen grows in large tracts in Northern Minnesota and in many places along the North shore of Lake Superior. Its food value is said to be three times that of the potato. Millions of reindeer musk oxen and other antelope thrive upon this hardy plant which they dig out from beneath the snow and the ice of the far North. Reindeer moss may sometime become an important source of human sustenance.

IRISH MOSS

This is an alga which has long been in use, especially as a delicacy for invalids. It is a seaweed which grows along the Irish coast. It has little, if any, food value and is much less used than formerly.

AGAR-AGAR

Sometimes called Ceylon moss, also known as Japanese or Bengal isinglass, obtained from a species of seaweed that grows along the coast of Japan and Ceylon.

Agar, taken in its crude state, is an excellent remedy for constipation, especially when its use is combined with paraffin oil as a lubricant.

Agar is also most valuable for all culinary uses for which gelatine is commonly employed. It makes much finer jellies than does gelatine, and is free from every objection which can be offered against the animal product. Being pure cellulose (hemicellulose) it cannot undergo putrefaction, and so may be used when most animal products are forbidden.

Agar is superior to animal gelatine not only in the fact that its flavor is not reminiscent of hoofs, horns, fragments of hide and sundry other slaughter house remnants, but also because it is more convenient in use. Agar melts at the temperature of boiling water, and congeals or jellies at a temperature above 120° F., and so does not require an ice box to harden or set even on the hottest summer day. It may be used for any purpose for which animal gelatine is used.

MUSHROOMS

The mushroom is practically of no value as a nutrient as the amount of digestible protein it affords is seldom more than 3 per cent, with an equal amount of carbohydrates. Whatever value it has is due to the meat-like flavor which it imparts to soups and other dishes. It is highly indigestible, and because of the frequency with which poisonous alkaloids are found in mushrooms, certain species of which are always poisonous, it is of very doubtful value as an article of food. The mushroom flavor, which is so highly relished by many persons, can now be obtained without the accompanying risk by the use of yeast extracts, (known commercially as Savita, Marmite, etc.).

Kakowski has shown experimentally that the eating of mushrooms, even those which are regarded as entirely wholesome, produces harmful effects in cases of nephritis.

THE AGAVE

A recent study of the leaves of the agave shows that they contain a considerable amount of useful nutritive material. The dried leaf contains more than twenty-five per cent sugar, an equal quantity of other carbohydrates, 16 per cent malic acid, and 15 per cent of salts, besides a considerable percentage of pectin.

It is said to be possible to prepare from the juice of the leaf a sweet, slightly acid marmalade suitable for food.

GREENS

We are only just beginning to appreciate the value and essential importance of greens as a staple constituent of the daily bill of fare. In this respect civilized people are far behind the rest of the world. The Chinese and Japanese, in fact, all Oriental people make great use of greens, as do savage or primitive tribes in all parts of the world. Dr. Turner tells us that "few people can compete with the Kaffir woman in making 'a spinach,' for which purpose the young shoots of innumerable plants are used, among others the sprouts of the pumpkin, the sweet potato, mandioca, and numerous wild plants." The North American Indians made use of purslane, pigweed, and many other common weeds as greens. The recent studies of the green leaf and of its dietetic uses have revealed many most interesting and important facts.

The most marvelous chemistry known to man is that which is wrought out in the secret laboratory of the green leaf. The sun is the alchemist, the chlorophyl grain the reagent. Here, in this simplest of laboratories, are formed all the marvelous products of the vegetable kingdom. Here are produced the subtle elements from which come all the curious gums and resins, oils and essences, all the delicate aromas,—the attar of the rose, the fragrance of the lily, the delicate scent of the violet, the penetrating odors of the leek and the garlic, the soporous smell of the poppy, all the deadly poisons of the nightshade and hemp, upas tree and bitternut, all the rainbow tints of leaf and flower, all the proteins and starches and fats of foods, the grain and fibre of all woods, and the bark of tree and bush and twig in all the forests of the world.

Chlorophyl was once supposed to be a single color, but now we know there are four, two greens and two yellows; and from these are compounded all the rest of the numberless tints that beautify the world of flowers in field and glen.

But the end is not yet. In the wonderful green leaf, itself the scene of marvelous activity in growth and development, is produced a substance that imparts to the young of animals the power to grow. Here is the explanation of the marvelous growth of calves, colts, rabbits, guinea pigs and antelopes. They seem almost to grow and expand before one's very eyes while he stands gazing in wonder and surprise.

Without this subtle vitamin which promotes growth and development, no animal could grow to maturity. Without it the reproduction of animal life would soon cease, and the world become waste and void.

It is for this reason that green vegetables, and especially "greens," are so important an element of the dietary. Cabbage, lettuce, spinach, cucumbers, greens of all kinds—some of these should be a part of every meal.

Here, too, is found the explanation of the importance of milk and dairy products in Nature's scheme of animal nutrition. In her perigrinations about the pasture, the cow gleans from grass and tender buds and twigs the precious vitamins, and gives them back in her generous lacteal fluid at milking time.

Nature has made more lavish provision for our sustenance than we appreciate. Our perverted instincts and erroneous dietetic habits have led us to overlook and ignore some of Nature's finest contributions to our welfare. We quite agree with the sentiments expressed by the writer of the following paragraphs, one of the experts of the U. S. Agricultural Department:

"What we call weeds are no more so than other plants that we term vegetables. Weeds are vegetables, and our so-called vegetables were once upon a time no more than weeds. The classification results from a matter of habit. We are slaves of habit, and because we are so it has not occurred to us that we could eat anything but just the old list of vegetables our ancestors have eaten for generations. But now we are having our eyes opened and are beginning to peer into fence corners and back yards and wild pastures for new and wonderful foodstuffs that we have heretofore regarded as just weeds. It is a bit mortifying that because of the preconceived idea we have let most nutritious and valuable foodstuffs go to waste under our very eyes, while perhaps we were wailing that we had little to eat and that vegetables were too expensive and so on.

"Among the plants thus neglected, but which, if properly improved and marketed, would enrich truck farmers, are yellow dock, dandelions, milkweed, golder thistles, mallows, purslane (*recommended by Thoreau*), poke-root, red clover, sorrel, hop shoots, yarrow, leek, and lupines."

All green leaves contain iron, lime, vitamins and other useful elements and may be used as greens when sufficiently tender for the purpose, provided no objectionable flavors or other noxious substances are present. Even grass and alfalfa have been used in emergency. The Chinese make use of a great number of greens which form a part of every day's bill of fare. The greens most commonly used in this country are spinach, New Zealand spinach, chard, dandelion, endive, mustard, turnip tops and lettuce. Lambs' quarters, a variety of pigweed, red root, purslane, and narrow leaved dock are other excellent greens which may be cultivated or gathered from fields or fence corners. The accompanying table shows the remarkable amount of lime and iron found in each. (Table XXIX, p. 285).

Through the courtesy of Dr. David Fairchild, head of the Plant Introduction Bureau of the U. S. Department of Agriculture, the writer recently received several plants of the Abyssinian *Rumex,* a relative of our native dock, which promises to be a most valuable addition to our own list of garden greens. This plant produces in abundance large tender leaves during the whole season. The stems are tender as well as the leaves. The presence of oxalic acid in considerable quantity is indicated by a distinct acid flavor, but this may be easily removed by parboiling without materially lessening the rich store of lime and iron found in this new *Rumex.*

Greens as Roughage.

Greens contain a very considerable amount of cellulose, and are thus an excellent sort of roughage. The amount of carbohydrates, protein and fats which they present is so small as to be almost negligible. But they are invaluable as the best sort of roughage, a source of the fat-soluble vitamin, one of the most precious of all vitamins, being an activator of growth, and lastly, a means of supplying to the tissues in a convenient and agreeable way, the essential requirement of iron and of lime.

Next to legumes, the greens show the highest iron content per ounce of any class of foodstuffs, the average being more than six per cent of the daily ration of iron. That is, approximately 16 ounces of a mixture of the several greenstuffs named in the table furnish iron sufficient for one day. This is, of course, more than one could conveniently eat; but a quarter or even a third of this amount may be easily eaten.

Of the ten most valuable "greens," the ones richest in iron are mustard greens, spinach, turnip tops, red root, dandelion and dock.

One of the best of all the greens is spinach which supplies in 15 ounces of raw material iron sufficient for a day. Dock and red root are so richly stocked with iron that only seven and a half ounces are needed to meet a day's requirement. An ounce and a half of dried spinach leaves will furnish iron sufficient for one day. The same amount of iron is supplied by half an ounce of the dried leaves of a common garden weed, the red root. An ounce of fresh spinach contains as much iron as an equal weight of ordinary beefsteak, and of a better quality.

It is important to remark about foods in general and of greens in particular that care must be exercised in cooking to prevent the loss of the lime and iron salts and the equally valuable vitamins. Parboiling, or boiling in water and drawing off and discarding the water in which the greens have been cooked, results in the loss of a small part of the useful elements of greens. Prolonged cooking at a high temperature is also damaging, and the same seems to be true of drying. It is important to make use of greens as soon as possible after gathering from the garden, while fresh and crisp. When wilted they become less tender. Canned greens are not equal in flavor to freshly gathered material but are nevertheless invaluable additions to the diet when fresh are not obtainable.

It is claimed for the newly perfected methods of preparing "evaporated" vegetables that the process does not destroy the vitamins, although they may be somewhat damaged.

Hindhede, the eminent physiologist of Copenhagen, wrote the author some time ago (1919) that he had kept a man in good health for twenty-three months on a strict diet of bread and potatoes with an abundance of "greens." Without the aid of the greens, a person would soon become anemic on such a diet.

We learn from a friend who has lived many years in Japan that the Japanese peasant always eats greens with his rice.

The Lime Content of Greens.

There seems to be in man as well as in lower animals an instinctive recognition of the important position held by these coarse and relatively innutritious products in Nature's scheme of nutrition. The craving for greenstuffs experienced by nearly everyone as Spring approaches, is the natural consequence of the widespread lime starvation imposed by a winter dietary from which foodstuffs rich in lime are largely excluded. It is true that this deficiency in lime, almost universally characteristic of winter dietaries, is not necessary, and may be easily prevented by a proper selection of readily accessible foodstuffs; but, unfortunately, the fundamental facts respecting the lime content of foods have only recently been brought to light through the researches, most laborious and painstaking, of the eminent Professor Bunge of Switzerland, and more recently by Dr. Sherman of Columbia University of New York. These facts are as yet practically unknown to the general public although of utmost vital importance.

In proportion to their nutritive value, there is no class of foodstuffs so rich in lime as are greens as shown in Table XIV. For example, polished rice contains one part of lime in two thousand calories; cornmeal, one part to nine hundred calories; beans, one to six hundred; whole wheat, one to four hundred; hazelnuts, one to one hundred; while in asparagus we find one part of lime to thirty calories; in cabbage one to twenty-four; cucumbers, one to fifty; dandelion, one to twenty-five; and in chard and celery, one to twelve.

Considered from the standpoint of bulk and weight, the situation is decidedly different. With a few exceptions, the lime content per ounce is not greater in "greens" than in many other vegetables. Notable exceptions are, chard, with a grain to the ounce; mustard greens, with 3 grains; paprika, nearly 1½ grains; turnip tops, 2 grains, and watercress with more than a grain.

As will be seen by a careful study of Table XIV, there is a marked difference between the different species of greenstuffs. Brussels sprouts, cucumbers, lettuce and romaine contribute to the diet no larger amounts of lime salts than string beans, green peas, onions, pumpkins and squash. Lettuce, cucumbers and celery are of no more value as sources of lime in the quantities eaten than are potatoes, their content of lime being very low. The really valuable greens, as sources of lime, are mustard greens, turnip tops, chard, collards, cabbage greens, endive and dandelion. Ordinary servings of three or four ounces of these greens will yield from 13 to 60 per cent of the daily lime requirement, as shown in the table.

It is clearly evident that greens are dependable sources from which lime salts may be obtained in almost any quantity desired. The small ordinary serving of 3 ounces may be easily doubled if occasion demands, as when it is necessary to replenish the depleted body stores of lime in a demineralized patient. By feeding greens twice a day and doubling the size of the serving, at the same time taking care to include in the bill of fare as many foods rich in lime as possible, one may easily increase his lime intake to three or four times the normal requirement, and thus rapidly make good the deficiency in salts which is not infrequently the fundamental fault in cases of chronic disease.

Among other excellent greens which may be mentioned are milkweed shoots, golder thistles, poke shoots, cowslip, red clover, yarrow, hop shoots, mallows. Purslane, now a neglected garden weed, was boiled and eaten in every cottage in the time of Charlemagne. It was a favorite of Thoreau and was presented to the early settlers of Massachusetts by the Indians who gathered it from their corn fields.

The tender leaves of the alfalfa have been used as greens with some success. The youngest leaves are selected, freed from stems, parboiled, well boiled, and made into a purée.

The root of the poke root is poisonous but its young shoots may be served when cooked like asparagus, which they much resemble. The young leaves make excellent greens resembling spinach. They should be twice scalded or parboiled.

Witloof is a variety of chicory. It is planted in the late spring or even late as June, to produce roots to be placed in the cellar in the late fall for winter forcing. The roots may be purchased in the late fall from gardeners. Serve as an uncooked salad.

The archeologists tell us that they find among the relics of ancient dwellings evidence that our primitive forbears made use of a vast number of plants which we now ignore, and some of which might be restored to our bill of fare with advantage. More than a hundred such plants, including several excellent greens, have been described by an English author, among which may be named, the red poppy, shepherd's purse, cuckoo flower, hawthorn buds, Alexanders, goat's beard, sow thistles, nettle, borage, marjoram, couch grass, and nipplewort.

TABLE XXIX.

Iron and Lime Content of Greens

	Lime		Iron	
	Grains per oz.	% of day's ration in 1 oz.	Grains per oz.	% of day's ration in 1 oz.
Cabbage Greens	.65	4.2	.008	3.4
Cardoon	.93	6.0	.033	13.2
Chard	.92	6.0	.010	4.7
Dandelion	.64	4.2	.012	5.1
Dock, Abyssinian				
Dock, Narrow Leaved	1.00	6.7	.028	13.4
Lamb's Quarters	1.90	12.5	.009	4.3
Endive	.99	6.4	.018	7.2
Imperial Kale	1.30	8.4	.019	7.6
Lettuce	.26	1.7	.003	1.3
Malabar Nightshade	1.42	9.2	.013	5.2
Mustard	3.01	19.6	.021	9.2
Portulaca Flora	1.45	9.4	.023	9.2
Purslane	.88	5.8	.008	3.9
Redroot	3.24	21.6	.028	12.9
Rocket Salad	1.32	8.6	.018	7.2
Spinach	.41	2.7	.016	6.8
Spinach, Mountain	1.27	8.5	.008	3.9
Spinach, New Zealand	.48	3.2	.009	4.1
Turnip Tops	1.05	7.0	.010	4.7
Watercress	1.15	7.5	.008	3.6

Botulism From Canned Spinach.

The recent occurrence of several deaths and many cases of sickness from the use of canned spinach, string beans and other vegetables has called attention to the danger from this source. Spinach and other canned vegetables should never be eaten without careful inspection of the cans before they are opened and of the canned contents immediately after opening. If the cans are bulged, or if the contents have the slightest unusual odor, the goods should be rejected. Botulism is in all cases the result of improper handling in the canning process. Through lack of cleanliness the raw material is infected and in "processing" the temperature employed is not sufficiently high to destroy the bacteria to which botulism is due. A wise precaution is to boil spinach, either canned or fresh, for five minutes before serving.

Salads.

In the Middle Ages, the salad was in high repute, and its value as a food accessory seems to have been very well appreciated. John Evelyn wrote a discourse on "sallets," and Chaucer and others dwelt upon the virtues "of the blood-cooling sallet." The cabbage, centuries before it acquired robustness, rotundity and variety through the ingenious tutelage of the old Dutch gardeners, grew wild on the shores of the Mediterranean, whence it was gathered to garnish the tables of the rich epicures of Rome.

The salad is deserving of more attention and better treatment than it receives in these degenerate days. It should be given the place of honor in the table service and should appear at two daily meals instead of one, and at the beginning of the meal instead of at the end. Thus treated, the salad, composed of fresh garden products rich in lime, iron, cellulose and vitamins, may become a valuable corrective and regulator and perhaps an efficient means of reforming our wretched modern dietary.

Among the plants most commonly used as salads are lettuce, cabbage, Chinese cabbage, cress, cucumber, endive, tomato, onion, beet root, cardoon, peppergrass, chevril, borage, burnet, mint, parsley, nasturtium, and sorrel.

Root Vegetables

This class of vegetables is characterized by a low content of fat and protein.

As regards carbohydrates there are two classes, those which contain carbohydrates in the form of insoluble starch and those in which the carbohydrates are in the form of sugar or dextrin, and hence soluble. The last mentioned class of vegetables are of special value in the feeding of diabetic patients, since by boiling two or three times they may be freed from their carbohydrates. In this class are the turnip, beet, parsnip, cabbage, egg plant, and spinach. The chief value of most vegetables lies in their rich store of alkaline salts and the valuable vitamins which they contain.

Steenbock and Gross have recently reported experiments which show that the carrot, the artichoke and dasheen are more satisfactory as sources of vitamins than are the sweet potato and sugar beets.

THE BEET

There are numerous varieties of beets which differ much in flavor, form, and nutritive value. The ordinary beet contains about 8 to 10 per cent of carbohydrates. Young beets are often eaten whole, the roots and tops being boiled together, and in this form are an exceedingly wholesome and valuable addition to the bill of fare. Mature beets are best prepared by steaming or baking. Boiled beets are commonly served with vinegar, which renders them more or less unwholesome. Lemon juice should be used instead of vinegar, for which it is more than a complete substitute since it is not only a wholesome food instead of a poison, but supplies vitamins and aids digestion and assimilation instead of hindering these processes.

THE PARSNIP

The parsnip has been cultivated and regarded as a valuable foodstuff for more than two thousand years. It is even richer than the beet in carbohydrates. In nutritive value it exceeds all of the other common root vegetables. The parsnip is best prepared by stewing or steaming.

THE CARROT

The carrot, like the parsnip, is an old-fashioned vegetable. It is much more palatable and edible when young than when mature. Its nutritive value is about the same as that of the beet. Its yellow color is due to carotin, a coloring matter which Hess has recently shown to be associated with the highly important fat-soluble vitamin which is essential for growth of young animals and for the maintenance of health in adult animals. Steaming is the proper method of cooking the carrot. When boiled in the usual way, the carrot loses a large portion of its nutrient value.

The carrot has long enjoyed a great reputation as a vegetable antiseptic. At Vichy, carrots are served in some form at every meal and are believed to be of value in combating intestinal putrefactions. Metchnikoff noticed that by feeding carrots to animals he could make their stools nearly free from bacteria.

Dr. Mary S. Rose and others have shown that on a diet consisting chiefly of carrots, the calcium balance may be maintained; that is, the daily intake of lime may be made to equal the daily loss. The amount of carrots eaten daily must be considerable.

THE TURNIP

This root, like the other common food roots, has been used from the most ancient times, and like them is found growing wild in most European countries. There are many varieties of this vegetable, the best of which is the swede. The turnip contains less carbohydrates than beets, parsnips or carrots, and no starch, for which reason it is much used for diabetics after removing the sugars and other soluble carbohydrates which it contains by repeated boilings. The turnip is richer in lime than other roots, and the tender tops may be used as a green or salad. Turnip tops contain more iron than any other green except red-root and dock.

SALSIFY—VEGETABLE OYSTER

A root which somewhat resembles the parsnip and has about the same nutritive value as the carrot. When cooked, it has a flavor somewhat resembling that of the oyster. The leaves or tops may be eaten as a salad or served as greens. In the black salsify the principal carbohydrate is inulin, which makes it a valuable food for diabetics.

THE RADISH

A highly succulent root which has a pungent flavor, due to an essential oil resembling the oil of mustard. The oil is found chiefly in the skin, which should be removed when this vegetable is eaten raw, as the essential oil is irritating, and while temporarily stimulating is in the end damaging to the gastric glands.

THE HORSE RADISH

This root contains a highly pungent and very acrid essential oil, on account of which it is used as a condiment. The oil of horse radish is highly irritating and its presence marks this vegetable as a poisonous weed rather than a food. It should never be eaten.

KOHL-RABI (TURNIP CABBAGE)

This is a curious vegetable in which the stored material is placed in an enlargement of the stem just above the ground instead of in the underground root. In flavor the kohl-rabi resembles both the turnip and the cabbage, but when young and tender is more delicate. Its store of carbohydrate is small, only 4 per cent, and its total nutritive value is also small. It is chiefly valuable for its alkaline salts.

THE JERUSALEM ARTICHOKE

The Jerusalem artichoke is a member of the sunflower family. It got its name from its resemblance in flavor to the true artichoke, a very different plant. It is a native of America and was much used by the aborigines, who carefully cultivated it in all parts of North America. It was cultivated in Italy nearly 300 years ago, where it got the name of "girasole" or sunflower artichoke. The word girasole was easily corrupted to Jerusalem, and the bulbs became known as "Jerusalem potatoes" from which was made "Palestine soup." Hopkins reports that the Jerusalem artichoke may satisfactorily take the place of the potato when necessary, although it is probably less well utilized.

The artichoke produces prodigious crops. Such enormous yields as 20 to 40 tons to the acre have been reported, which is many times the yield of the potato or any other root crop.

The artichoke should be steamed rather than cooked in water as this prevents loss of flavor and aroma. A still better plan is to place in a hot oven in a covered dish with a little butter and salt. No water should be added. This bulb is worthy of more consideration than it has heretofore received.

Colin finds that the inulin of the Jerusalem artichoke is during the winter converted into sugars which in the spring are utilized in starting the new growth. In the use of artichokes by diabetics note should be taken of this fact and the sugar removed by parboiling when a low intake of sugar is required.

CELERIAC

This vegetable has a root similar to that of the turnip. It has the flavor of celery and is cooked and served like the turnip. It is deserving of more attention than it has received up to the present time.

Vegetable or Garden Fruits

Among the most commonly used vegetable fruits, or fruits produced by annual plants, are the tomato, the cucumber, the chayote, the eggplant, the citron, watermelon, muskmelon, squash, pumpkin, and vegetable marrow.

THE TOMATO

The tomato is one of the best and most useful of our garden fruits. It was introduced to Europeans by Sir Walter Raleigh, who first discovered it on Roanoke Island. It was long cultivated as an ornamental plant, but has only been extensively used as a food during the last 70 years. There are people still living who first knew the tomato as a show plant in the flower garden, then known as the *"love apple."*

For a long time after the tomato began to appear on American tables, it was suspected of being the cause of cancer, though without the slightest ground for such a prejudice, and was avoided by many people on this account.

Steadily the tomato has won its way into popular favor until now there is no garden vegetable so largely and universally used in this country as is the tomato, with the exception of the potato. The same is equally true in Mexico, Italy, and several other countries.

The tomato contains nearly twice as much iron as does milk, and five times as much as egg white; in fact, it is richer in iron than apples, pears, oranges, grapes, melons, cucumbers, and peaches, and contains more than half as much as onions, parsnips, turnips, radishes, sweet potatoes, kohl-rabi, eggplant, carrots, celery, cauliflower, chestnuts, beets and bananas. Of lime, the tomato contains more than apples, bananas, and rice, and as much as hominy, corn flakes, and eggplant, and more than three times as much as beef, mutton or fish.

The tomato is also rich in useful potash salts, of which it contains more than most fruits and many other vegetables. The tomato owes its acid flavor to citric rather than oxalic acid as was formerly supposed.

Givens has shown that raw tomatoes may be dried at a temperature of 60° C (140 F.) without destroying the antiscorbutic vitamin. The vitamins are also uninjured by canning.

Vitamins in Tomato Juice.

Hess has shown that the juice of canned tomatoes is a most valuable source of vitamins. Its superlative value is due to the fact that it contains all three of the food essentials, or vitamins, while most fruit and vegetable juices are deficient in one or more.

Hess recommends that the juice of canned tomatoes should be given to infants instead of orange juice as being less expensive. The average infant requires about one ounce daily.

Observations by Mendel showed that one-tenth of a gram (one grain and a half) of dried tomato contains a sufficient amount of the fat-soluble vitamin to take the place of butter in the dietary of growing rats and to bring them quickly to full maturity. An equivalent amount for a human being would be about one-half ounce of dried tomato per day or four to six ounces of fresh tomatoes.

THE CUCUMBER

One of the first cultivated plants, the cucumber, has been known for more than 2000 years. The cucumber is still largely used in Egypt, where it is almost a food staple and is much eaten by children and even infants, as well as by adults, thus proving its essential wholesomeness. In this country the cucumber is usually spoiled by pickling before it appears upon the table. Fresh cucumbers, well masticated, are wholesome and valuable as sources of vitamins and salts which help to maintain the alkalinity of the blood, and also furnish roughage.

THE EGGPLANT

The eggplant contains, in small quantities, a poisonous alkaloid and an irritating substance, both of which may be removed by parboiling for two or three minutes before cooking. Prepared in this way, it is a wholesome plant and a valuable source of food alkalies and vitamins.

THE WATERMELON

A native of ancient Egypt and of America. It was discovered by Sir Walter Raleigh when he discovered Roanoke Island in 1584. A very valuable fruit on account of the large amount of sugar found in its juice. When eaten in quantity, the pulp should be rejected as the total food value is in the juice.

THE MUSKMELON

All the different varieties of this excellent melon are wholesome. It is richer in alkalinizing elements than any other vegetable food and hence may be freely eaten with advantage by persons who have a tendency to acidosis.

THE SQUASH AND VEGETABLE MARROW

The several varieties of squashes are chiefly valuable for the vitamins and alkali-forming elements which they furnish.

The vegetable marrow is a wholesome and valuable garden fruit with properties similar to those of the squash, though its nutritive value is less.

THE PUMPKIN

This gigantic fruit is a contribution from our Indian predecessors who cultivated it in their corn fields. It is a coarse, crude product, but when properly prepared is a wholesome and grateful addition to the bill of fare and yields a good share of useful food salts and vitamins together with a minimum of nutriment in the form of starch, dextrin and sugar.

THE CHAYOTE

This new garden vegetable, recently imported from Mexico, is a relative of the cucumber. It grows on a vine trained upon a trellis, and when fully matured is about the size of a small apple. The chayote, like the cucumber, is somewhat lacking in flavor, but when cooked and served with some suitable sauce is an acceptable addition to the bill of fare in early winter. It is sold in the New Orleans markets.

Legumes

There are many species and many varieties of legumes. The bean and the lentil have been known from very ancient times. Many varieties of beans were cultivated by the aborigines of this country. The lentil has been a staple food in the Orient from remote ages. The soy bean has been the meat and milk of China for thousands of years.

With the exception of the soy bean, beans, peas, and lentils are much alike in composition. The soy is richer than other legumes in fat and protein.

All the legumes are very rich in lime, iron and vitamins.

Legumes differ from most other vegetable foods in the fact that they contain an appreciable proportion of purin bodies, which are converted in the body into uric acid. This amount is small, however, compared with that contained in meat. Dried beans contain only four grains of uric acid (xanthin) to the pound, whereas dried meat contains 56 grains.

The protein of beans is inferior in quality to that of the cereals, potatoes and nuts, as well as to that of meat, milk and eggs, being "incomplete." This is not true of the soy bean, however which furnishes a protein of high quality.

Digestibility of Legumes.

The comparative indigestibility of the protein of vegetables has been urged as an argument in favor of flesh foods and as an objection to the use of vegetable foods. The evidence is accumulating, however, that the discrimination against vegetables in this regard has been unfair and based upon inaccurate observation. Lean meat consists of the soft pulp of the muscle tissue proper held together by a framework of connective tissue. The connective tissue is completely digested and dissolved by normal gastric juice. Thus lean meat is well broken up in the stomach by gastric digestion, even though it may be swallowed in masses and without sufficient mastication. The nutritive substance of vegetable foods is imprisoned in a meshwork of cellulose which is not acted upon by either the saliva or the gastric juice and hence cannot be dissolved in the stomach. The consequence is that if vegetable food is not thoroughly reduced to a paste in the mouth but through hasty eating is swallowed in masses, quite a common practice, the necessary result is incomplete and tardy digestion. Only that portion of the starch will be digested with which the saliva can come in contact, and only such portions of protein will be dissolved as are brought in contact with the gastric juice, so a considerable portion will escape digestion altogether.

Dr. Wait, an expert employed by the United States Government in the study of foods, some years ago published a most interesting account of experiments by which he showed that legumes, when properly cooked, have a very high degree of digestibility. Cooking in hard water impairs their digestibility, but when cooked by the Japanese methods, the results are most excellent. For example, the Japanese *to fu*, which is prepared from the soy bean, has a digestibility for protein of 97%, and for carbohydrates of 88%.

It should be noted that cooking in hard water has the effect to harden the protein of legumes and lessen its digestibility.

Experiment has shown (Adkins) that the digestibility of beans may be increased as much as 15 per cent. by sprouting. This increase of digestibility disappears, however, if the sprouted beans are dried. After sprouting they must be kept moist until used.

Alkalies to be Avoided.

The common custom of cooking beans with soda or saleratus to soften the seed coverings is most objectionable. Alkalies exercise a powerfully destructive effect upon vitamins; hence the practice referred to cannot be too strongly condemned.

The Iron Content of Legumes.

The product of a most extraordinary class of plants, the legumes (beans, peas and lentils) are the richest of all vegetable foods in food iron. The lentil, richest of all, contains exactly the same amount of iron per ounce as the egg yolk, a percentage so great that a full day's ration is supplied by six ounces of the raw material. The lentil has been serving the human race as a blood builder from the most ancient times.

Beans, both navy and lima, are almost equally rich in the blood-making element, seven ounces being sufficient for a complete iron ration for a day.

Peas furnish not quite two-thirds as much iron as do lentils, but nine ounces suffice for a day's ration. Even green peas are equally well stocked with iron if the estimate is based upon food values, one hundred calories furnishing one-ninth of a day's requirement of iron.

The ruddy and well-nourished condition of the famous Hebrew children who insisted on sticking to their accustomed fare of "pulse," rejecting the juicy venison and mutton chops of the King's table, must have been due, then, to the liberal ration of iron which they received, rather than to a high protein intake. Peas and lentils are just as good for the children of the present generation as for those of Nebuchadnezzar's day.

The Lime Content of Legumes.

The legumes furnish in small bulk so large a store of lime that they are most useful in balancing up the bill of fare. This may be clearly seen by reference to Table XIII, which shows us that an ounce of beans contains a grain of lime. An ordinary serving represents about an ounce and a quarter of dry beans, which would supply 8 per cent or one-twelfth of a day's ration.

Peas have a lime content about half that of lentils, and two-thirds as much as beans. When made a staple of the bill of fare, the size of servings may be increased to two or even three times the ordinary, making the bean supply nearly one-fifth of the day's ration of lime.

Legumes, particularly lentils, are deserving of a larger place in the dietary than has heretofore been accorded them. Their use has been restricted somewhat, perhaps, by the fact that much more time and skill are needed to render them an attractive feature of the bill of fare than is required for cereals and vegetables. Many breakfast foods are ready to serve straight from the carton. Oatmeal may be served in ten minutes if the water is already hot. Potatoes go into the oven and out again in half an hour, and other vegetables take care of themselves in a fireless cooker. But beans need several hours exposure to full cooking heat under carefully regulated conditions to render them acceptable to both the palate and the stomach; and so the bean is not popular with the cooks except perhaps in the vicinity of Boston, unless supplied in tins ready cooked from the grocer.

The solution of the bean problem will be found in the pressure cooker, the next improvement needed to equip the complete modern kitchen. At a temperature eight or ten degrees above the boiling point of fresh water beans cook very quickly, in an hour easily, and they are improved in flavor also. And still further, the tough woody hulls are so softened that they occasion less disturbance in the intestinal tract, being readily broken up.

A word of caution must be said in relation to the use of legumes. The elaborate feeding experiments of McCollum and others have shown that the protein of beans is of inferior quality and by no means a substitute for the fine protein of milk. This fact is important in this connection because of the possible injury in making the diet consist so largely of beans as to overburden the body with the elimination of unusable protein. The proteins of peas and lentils are superior to those of beans; hence it is advisable to utilize these legumes more largely than beans as a source of food lime and its associated protein. Beans should be supplemented by cottage cheese or nuts, one to three ounces.

When the soy bean has become well established in this country as a food product, it will be doubtless recognized as a superior source upon which to draw for extra supplies of a fine quality of vegetable protein.

BEANS

Beans and other pulses are among the most ancient of cultivated foodstuffs. The ancient Egyptians worshiped the bean because of its resemblance in shape to the kidney and to the male sex gland. They refused to eat this legume, fearing that in so doing they might be consuming a human soul consigned by fate to expiate its sins by a term of life in this humble plant.

The old Romans used beans in their religious services, and threw black beans on the graves of their deceased friends as a part of the burial service. At Roman feasts in memory of the dead, beans were cast upon the altar fire. It was their belief that the odor of burning beans would drive away evil demons.

This ancient superstition in relation to beans still survives among the modern descendants of the Romans. In Italy, it is at the present day customary to eat beans on the anniversary of the death of a friend and to distribute the seeds among the poor.

An ancient Jewish ceremonial law forbade the use of beans by the high priest on the day of atonement, because of the belief that the eating of beans caused drowsiness.

Pythagoras thought the black spot on the bean to be an emblem of death, and warned his followers to avoid eating beans.

A relic of these old superstitions still survives in some of the countries of England, where it is commonly believed that sleeping in a bean field will cause bad dreams or even insanity.

Beans were among the few vegetables cultivated by the

Indians when this country was discovered by Europeans. They planted pole beans with their corn, and had developed many varieties of the legume from which many of our modern beans are derived.

The kidney or haricot bean occurs in many varieties, white, red, navy bean, etc.

Broad beans, lima beans, butter beans and frijoles, are other varieties the characteristics of which are so well known as to require no description.

The bolicohs bean is a new variety which differs slightly from the common bean, and is much liked by those acquainted with it. Two varieties are well known, the *hyacinth* and the *asparagus.*

The Mung Bean.

The composition of the Mung bean is very similar to that of the ordinary bean of this country. According to Church, the composition is water, 11.4; ash, 3.8; protein, 23.8; fat, 2.0; fiber, 4.2; carbohydrates, 54.8. The best bean for sprouting.

The Adsuki Bean.

Another variety introduced into this country from Japan is the Adsuki, a red bean which closely resembles the Mung in composition. It is the favorite bean of Japan, where it commands the highest price. It has a delicious flavor, being wholly free from the beanny taste characteristic of the American varieties of this legume. Tests made by the Plant Introduction Bureau of the Agricultural Department show that this bean can be readily grown in this country and it will doubtless in time achieve high rank as a staple foodstuff.

String Beans.

The unripe bean pod with its contents, so-called snap beans, when properly cooked and served, is not only very palatable but a highly valuable vegetable dish for which we are indebted to the American Indian from whom Europeans learned its value.

Shelled Beans.

This is a very excellent and easily digestible vegetable when properly cooked and served. The relative proportions of protein, carbohydrates and salts are about the same as in the ripe bean, but the quantities only half as great on account of the large amount of water present.

The Hahto bean, a Chinese variety, which is about half the size of the lima bean, is superior to all other beans for use as a green vegetable. In cooking, it requires only the addition of a little salt, since it contains a considerable percentage of a very digestible fat. The flavor developed in the cooked bean is most delicious. This choice vegetable has recently been introduced into this country by the U. S. Department of Agriculture, from whom information can be obtained concerning seed. It is quite hardy and ought to be planted in every garden.

Succotash.

Succotash is a dish invented by the American aborigines, by whom it was known as "sawquetash." It consists of a mixture of shelled beans and green corn cooked together.

THE SOY BEAN

The soy bean has been used in China since 2838 B. C. It was introduced into France in 1740, England 1790, and this country not until a century later. This bean requires a long season and does best in the Southern states on this account. It is quite hardy, however, and some varieties have been found which mature as far north as Canada.

The soy is the best of all the beans. It differs decidedly from other beans in its composition. It contains 40% protein, practically no starch, and nearly 20 per cent fat, giving it characteristics approaching those of the peanut more closely than those of ordinary beans.

More than one thousand varieties have now been tested by the U. S. Department of Agriculture. Twenty varieties are at the present time being handled by growers and seedsmen in this country. The green and yellow varieties are best adapted for food. The black and brown are chiefly grown for forage.

In China, the soy bean is very little used in the manner in which beans are used in this country. Instead, according to W. J. Morse, of the U. S. Department of Agriculture, "the beans are soaked in water and roasted, the product being eaten after the manner of roasted peanuts. This method of preparing the beans is improved by soaking the beans for about twelve hours in a 10 per cent salt solution, boiling slowly for about thirty minutes, and then roasting to a light-brown color. The yellow-seeded and green-seeded varieties are preferable, as they make a product of better appearance."

"When soy beans are three-fourths or more grown, the seed makes a most palatable and nutritious green vegetable. As such it may be used much as is the green pea or the Lima bean. The pods are somewhat tough and not desirable to eat. The green beans are rather difficult to shell, but after cooking in the pods for about five minutes they shell out very easily. These beans may also be canned, like green peas, and they thus make an excellent green vegetable for the winter."

This bean not only contains a large amount of protein, more than is found in the same weight of beef, but its protein is of a particularly fine quality. Heretofore, the casein of milk has enjoyed a unique reputation as a protein of finest quality, but now "the protein of the soy bean appears to be as valuable as the casein of milk."

In view of the shortage of milk, which is likely to increase, it is gratifying to know that a protein has been discovered equally valuable as casein, and one which may be produced in unlimited quantities.

For the promotion of growth, it is not only necessary for the food to contain "complete" protein in proper amount, but it must also contain a sufficiency of the two vitamins, designated as fat-soluble *A* and water-soluble *B*. Osborne and Mendel demonstrated that the soy bean contains an adequate supply of both fat-soluble and of "water-soluble vitamins," in which respect it is superior to all seeds heretofore examined, with the possible exception of flaxseed and millet.

The soy bean is destined to become one of the great food staples, not only of this country but of the world. It is capable not only of supplying the essentials for growth and maintenance, but may also act as a complement to other imperfect foods, such as corn for example, in combination with which it has shown most excellent experimental results.

Composition of the Soy Bean.

The following table is compiled from the analyses published by the United States Government and by Bailey and Street, (Journal of Industrial and Engineering Chemistry, 1915) :—

	Per Cent.
Ash	4.8
Water	8.5
Protein	39.5
Fat	18.5
Starch	0.5
Cane sugar	3.0
Invert sugar and raffinose	1.2
Dextrin	3.0
Galactan	5.0
Pentosan	5.0
Wax	8.0
Cellulose	3.0

The above analysis clearly shows the soy bean to be a most remarkable food product. Its composition is in some respects more like that of a nut than that of other legumes. In this respect it very much resembles the peanut. Its protein content, nearly 40 per cent, is higher than that of any other foodstuff. Even lean meat affords but half as much. Its high percentage of fat gives it a very high food value and makes it a rich source of oil for various industrial purposes as well as for food.

The soy fills the place of meat as well as milk in the dietary of many millions of sturdy Orientals. Since the composition of the soy has been understood, it has been much used as a food for diabetics. It is evident from the above that it contains little which can be objectionable in diabetes. The small amount of dextrin and sugar may be easily removed, when necessary, by parboiling.

Experiments by Holmes, of the office of Home Economics, U. S. Department of Agriculture, have shown that the well cooked soy bean (cooked for two hours under steam pressure) is very easily digestible, and is an exceptionally wholesome article of food, superior to most other legumes.

The soy bean may not become really popular until the pressure cooker comes into general use, which may be some time. In the meantime, while the patent pressure cooker is coming, any resourceful housewife may improvise a perfectly good and satisfactory pressure cooker from inexpensive materials close at hand. Get a stone jug or jar that can be hermetically closed. The little stone jars in which apple butter is sometimes sold are well adapted to the purpose. After soaking the beans over night put in the jug with a little salt and enough water to cover, seal up tight and secure the cover well, remembering that the pressure will be from within. Set the jug in a saturated solution of common salt, place over a smart fire and boil for one to two hours. The salt solution boils at a temperature above 220° F. and so the beans are exposed to a higher temperature than in ordinary boiling. This method is equally good for greens, cabbage, and ordinary beans. Cooking at the higher temperature not only softens the cellulose and so renders the foodstuffs tender, but greatly improves the flavor.

Soy Bean Milk.

In Japan infants are sometimes nourished artificially on milk prepared from the soy bean by methods for a long time kept secret. Soy milk is now well known and quite extensively in use in France and England, and likely soon to be introduced into this country. The writer has prepared, experimentally, a quite palatable milk from the soy bean, and has for twenty-five years made use of milk prepared from the almond and other nuts.

The beans may be prepared either by grinding to a fine flour or by soaking over night and crushing to a pulp between rollers. The dry meal is most convenient. Add to the dry meal sufficient water to a little more than saturate. Allow to soak for two hours. Add five times the quantity of boiling water. Boil for ten minutes, stirring. Filter through a fine cloth. The milky liquid thus obtained has properties very closely resembling cow's milk. It is rich in protein and fats. The fat is well emulsified and easily digestible, and the protein very closely resembles that of milk, being what is known to chemists as a complete protein which may replace the casein of milk as a food. The soy milk is rather deficient in salts, both lime and iron. It contains vitamins but less than milk, and it contains no carbohydrates. To be used as milk it should be sweetened by the addition of 2 per cent of cane sugar or 4 per cent of milk sugar. To suit most palates a little salt should be added also. The flavor is different from that of cow's milk, but it is wholesome and not unpalatable and may to a considerable extent take the place of cow's milk by persons who are sensitized to milk or when milk is not available. A similar preparation may be made from peanuts.

Soy bean milk, according to Adolf and Kiang, has the following percentage composition:

Protein	4.22
Fat	1.87
Salts	.40
Water	93.51

The composition of the milk will vary, of course, with the amount of water used in its preparation. It will be noted that soy milk contains no sugar and is very poor in salts, containing only half the amount of salts found in cow's milk. All these may be easily added, however, and so soy milk is a possible resource for lacteal food in case of scarcity of the bovine product; but it seems to the writer doubtful that soy milk will ever be able to compete with cow's milk as a nutrient for human beings, and especially the feeding of infants.

To Fu.

This is a cheese like preparation made from the soy bean, much used in China. The method is as follows:

Prepare soy bean milk. While it is boiling add one-fifth its volume of a one-half per cent solution of citric acid, stirring. Strain through a cloth to separate the curds.

To fu omelet is more palatable and more wholesome than ordinary egg omelet. It is made as follows: Four ounces of to fu, one rounded tablespoonful of graham flour, milk sufficient to give the mixture the consistency of pancake batter. Add one well beaten egg. Cook in the usual way. This to fu or soy bean omelet is more wholesome than the ordinary egg omelet and is more easily digestible. Made without the addition of flour the to fu omelet is a valuable dish for diabetics.

The following is the composition of to fu as given by Adolf and Kiang:

Protein	10.22
Fat	3.66
Salts	1.09
Extract	4.13
Water	80.90

To fu is used in soups and salads and in a great variety of combinations with other foodstuffs. It is one of the fundamental things in Chinese and Japanese cookery.

Soy Sauce.

"Soy or shoyu sauce is a dark-brown liquid prepared from a mixture of cooked and ground soy beans, roasted and pulverized wheat (barley is sometimes used), salt, and water. This mass is inoculated with a culture known as rice ferment (*Aspergillus oryzae*) and left in cakes to ferment from six months to a year, or sometimes longer."

"In odor and taste this sauce suggests a good quality of meat extract, though perhaps more salty and a trifle more pungent."

Soy Bean Sprouts.

"Several species of beans are sprouted and used as a garden vegetable by the Chinese. Soy beans are used to a very considerable extent for this purpose, as these sprouts are larger and firmer than those of most other legumes. Bean sprouts may be used as a home winter vegetable, for the dried beans are sprouted easily in a short time under proper conditions of heat and moisture."

Mr. Shih Chi Yien of the Foochow University gives the following directions for preparing bean sprouts, for which purpose either yellow or green soy beans or the Mung beans may be used.

"The beans must be thoroughly washed as a preparation for growing the bean sprouts. Then they are poured into a big vessel which is about three feet high and one foot and a half in diameter. In the bottom of the vessel a small hole is made for draining the water off from the beans. The vessel is covered with a straw cover to keep out the light."

"The beans must be moistened at least three times each day in the summer time and twice in the winter time. They are kept in the vessel about three days in the summer and fifteen days in the winter. At the end of the time, the sprouts are fully grown and they are taken to the market for sale."

Another method of sprouting is to spread the beans one layer thick on a wet cloth and cover with a heavy wet, dark colored cloth which must be kept damp by frequent sprinkling.

Bean sprouts are used as a green vegetable at all seasons of the year. In this country they would be especially useful in the winter season because of their richness in vitamins. They have been much used in combating beri-beri and other deficiency disorders. Their use in this country should be encouraged.

The sprouts may be served raw as a salad or cooked as a green vegetable. They are a constituent of the famous Chinese dish, "chop suey."

THE PEA

The garden pea has been known in Europe from prehistoric times. There are many varieties, which differ in mode of growth and appearance and to some extent in flavor, but are practically identical in composition. When mature and dry, the pea contains about 25 per cent of its weight of protein and 62 per cent of carbohydrates. The protein of the pea is superior in quality to that of the bean, a fact which should lead to the more extended use of dried peas.

Green Peas.

A very delicate and delicious vegetable containing a considerable amount of sugar, which in the ripe pea is converted into starch. Both the protein and the carbohydrate is much smaller in amount in the green pea than in the ripe pea. Canned green peas are a valuable addition to the dietary in the cold months. Care should be taken to avoid peas which have been colored with copper or sweetened with saccharine.

LENTILS

Lentils have been used as a food from prehistoric times. The red pottage which Jacob gave Esau in exchange for his birthright was prepared from the red or Egyptian lentil which has been a staple article of food in Egypt for thousands of years and has in recent times been introduced into this country. Lentils are much used in India as a supplement to the rice diet which is widely used in that country. The lentil contains somewhat more protein than either beans or peas and does not produce offensive flatulence as do beans, because of the absence of sulphur. Lentil is best served in the form of soup. It is a highly valuable vegetable and should be more widely used. Rich in iron and lime.

DRIED VEGETABLES

Within recent years processes have been perfected whereby vegetables may be preserved by drying with comparatively little change in their flavor and nutritive qualities. It is necessary, however, that the drying should be accomplished at a low temperature to avoid destruction of some of the valuable vitamins which abound in most vegetables. It is also necessary that the vegetables should be sliced and dried while still fresh, or within a few hours after gathering, and the dried product should be kept in closed containers, as exposure to the air permits deterioration.

Recent observations by Osborne and Wakeham show that little change results from the drying of spinach and other green leaves at low temperatures. The proteins of the dried leaf are slightly more soluble than are those of the fresh leaf. It thus appears that drying may be found an excellent means of preserving such greenstuffs as spinach, dock and other greenstuffs which possess a high value as foodstuffs, an important fact recently determined by animal feeding experiments which heretofore has received little consideration.

While dried vegetables are not quite equal to fresh in flavor and may in this respect even be slightly inferior to canned vegetables, this mode of preservation affords a cheap and simple method of disposing of the surplus of this important class of foodstuffs which often occurs at certain seasons of the year and hence should be utilized more extensively than heretofore. Dried vegetables, particularly dried potatoes have for many years been used to a very great extent in Germany and some other continental European countries.

Fruits

Fruits may justly be regarded as among the most refined, as well as the most delicious, of natural food products. Their attractive aroma, due to the presence of essential oils, their tasty and refreshing juices, together with their valuable sugars, vitamins, salts and acids, give to them a very important place in the category of useful foodstuffs. With few exceptions, fruits contain practically no fats and only minute quantities of protein, rarely more than one-half per cent. to one per cent.

The carbohydrates of fruits are chiefly in the form of sugar, dextrin, and acids, and are for the most part ready for immediate absorption.

The absence of fat and the presence of minute quantities of protein, and the fact that the sugar is generally in a form in which it can be immediately assimilated, renders fruits, of all foodstuffs, the least taxing to the digestive organs. The nutritive material which they contain being ready for immediate use, accounts for the almost immediate refreshing effects experienced by a fatigued person from the drinking of fruit juices and for the great popularity of fruit juices of all sorts, especially in seasons of the year when the depressing effects of exercise are most generally felt.

Edible fruits occur in greater variety than does any other form of food. This is especially true in the tropics. More than 300 different edible fruits are known.

Of the three acids found in fruits, citric and malic acid are the most common. Tartaric acid is found almost exclusively in grapes. Varying quantities of dextrin and small quantities of starch are sometimes found in fruits, especially in unripe fruits. The sugar of fruits usually consists of a mixture of about equal parts of dextrose, or grape sugar, and levulose, or fruit sugar, sometimes called fructose. Cane sugar is found in large proportion only in a very few fruits.

TABLE XXX.

Showing the Amount of Sugar in Common Fruits

	Per cent.	Calories per ounce
Hot-house Grapes	17.26	19.7
Preserved Grapes	16.50	19.1
Figs (fresh)	11.55	13.2
Cherries	10.00	11.6
Preserved Pears	8.78	10.0
Fresh Pears	7.84	9.0
White Currants	6.40	7.3
Strawberries	5.86	6.7
Preserved Apples	6.25	7.1
Raspberries	7.23	8.3
Oranges	8.58	9.8
Apricots	8.78	10.0
Pineapples	13.31	15.2
Plums	1.99	2.1
Lemons	1.47	1.7

The amount of cane sugar and other sugars found in fruits, together with the amount of acid and the caloric value is shown in

TABLE XXXI.

In the following table there are given the proportions of acid, sugar, and pectin in some common fruits (Watson):

	Acid	Sugar	Pectin
Apples	1	11.2	5.6
Apricots	1	1.7	6.1
Blackberries	1	3.7	1.2
Currants	1	3.0	0.1
Gooseberries	1	4.9	0.8
Grapes	1	20.2	2.0
Peaches	1	2.3	11.9
Plums	1	1.6	3.1
Prunes	1	7.0	4.4
Raspberries	1	2.7	1.0
Strawberries	1	4.4	0.1

All ripe fruits are easily digestible in a raw state when properly masticated. Cooking softens the cellulose, coagulates the pectin or jellifying principle of fruits, and renders them somewhat more digestible but lessens their nutritive value by destroying in part the vitamins which give to them one of their chief nutritive values. The antiscorbutic, or scurvy-preventing vitamins, may be wholly destroyed in the cooking of fruits. On this account, fruits should be largely eaten in the fresh or uncooked state. Drying also injures this vitamin.

Fruits are worthy of a more dignified place in the dietary. They are usually regarded as a luxury to be indulged when convenient or when they can be afforded; whereas they should be considered an essential part of the dietary. Nature has so distributed the various items which make up a complete biologic ration that it is necessary to include in our list of edibles all parts of the plant,—leaves, buds, roots, seeds, and fruits in order to be certain that nothing is missed. This has been clearly shown by McCollum's classical experiments. Fruits supply in more palatable though less concentrated form much the same food essentials that are found in roots, viz., carbohydrates, roughage, and especially the alkaline salts of which we need a considerable amount to neutralize the acid wastes of our bodies which are greatly exaggerated by a sedentary mode of life and a high protein diet.

Ripe fruits require little work of the digestive organs. Their sugars, acids, salts, and vitamins are all ready for immediate absorption, while the amounts of fat and proteins present are so small that they are quickly disposed of. For this reason, fruit alone of all natural foodstuffs, may be eaten at any time when the stomach is not overfilled, without disturbing the digestive process. This license does not apply, of course, to those highly concentrated foods, the date, fig, raisin or other dried fruits.

The cultivation and use of fruits should be greatly extended. Man is naturally a frugivorous animal, like his relatives the big apes, and should find in fruits a large part of his nourishment. Fruit trees should be planted along all our highways and on suitable land not otherwise occupied, especially those hardy species which are able to flourish with little attention from the hand of man.

Scurvy, beri-beri, and other deficiency diseases may owe their origin to the absence of fresh fruit.

The "fruit regimen," described elsewhere in this work, is one of the most effective means of changing the intestinal flora and lifting from the liver and kidneys an enormous burden of onerous and destructive work in poison elimination. The free use of fruit is a most effective means of combating intestinal autointoxication, constipation, a condition of demineralization, and deficiency disorders such as chronic scurvy.

John Hunter advocated the free use of apples as the best remedy for gout. The great naturalist, Linnaeus, cured himself of a severe attack of sciatica by eating freely of strawberries. Tissot tells of a regiment of soldiers suffering from dysentery who were quickly cured after encamping close to a vineyard full of grapes.

The medical history of the Civil War recounts a similar experience by a regiment of soldiers from which a scourge of dysentery disappeared very quickly after their camp was located near an orchard of ripe peaches.

TABLE XXXII.

Showing the Composition of the Edible Parts of Fruits.

	Water	Proteid	Carbohydrates	Ash	Cellulose	Acids	Calories per oz.
Apples	82.5	0.4	12.5	0.4	2.7	1.0	15.4
Apples (dried)	36.2	1.4	49.1	1.8	4.9	3.6	59.8
Pears	83.9	0.4	11.5	0.4	3.1	0.1	13.7
Apricots	85.0	1.1	12.4	0.5		1.1	15.5
Peaches	88.8	0.5	5.8	0.6	3.4	0.7	7.0
Greengages	80.8	0.4	13.4	0.3	4.1	1.0	
Plums	78.4	1.0	14.8	0.5	4.3	1.0	15.3
Nectarines	82.9	0.6	15.9	0.6			18.8
Cherries	84.0	0.8	10.0	0.6	3.8	1.0 to 1.5	13.0
Gooseberries	86.0	0.4	8.9	0.5	2.7	1.5	11.4
Currants	85.2	0.4	7.9	0.5	2.7	1.5	11.4
Strawberries	89.1	1.0	6.3	0.7	2.2	1.0 to 1.2	9.0
Blackberries	88.9	0.9	2.3	0.6	5.2		3.7
Raspberries	84.4	1.0	5.2	0.6	7.4	1.4	8.0
Cranberries	86.5	0.5	3.9	0.2	6.2	2.0 to 2.5	6.0
Mulberries	84.7	0.3	11.4	0.6	0.9	1.8	14.4
Grapes	79.0	1.0	15.5	0.5	2.5	0.5	19.1
Melons	89.8	0.7	7.6	0.6	1.0		9.5
Watermelons	92.9	0.3	6.5	0.2			7.8
Bananas	74.0	1.5	22.9	0.9	0.2		27.9
Oranges	86.7	0.9	8.7	0.6	1.5	1.0 to 2.5	12.1
Orange juice	85.0		10.8			1.93	15.3
Lemons	89.3	1.0	8.3	0.5			11.0
Lemon juice	90.0		2.0	0.4		7.0	6.3
Pineapples	89.3	0.4	9.7	0.3			11.5
Pomegranates	76.8	1.5	16.8	0.6	2.7		20.9
Dates (dried)	20.8	4.4	65.7	1.5	5.5		80.1
Figs (dried)	20.0	5.5	62.8	2.3	7.3	1.2	76.7
Figs (fresh)	79.1	1.5	18.8	0.6			23.2
Prunes (dried)	26.4	2.4	66.2	1.5		2.7	70.0

	Water	Proteid	Carbo-hydrates	Ash	Cellu-lose	Acids	Calories per oz.
Prunes (fresh)	80.2	0.8	18.5	0.5			22.2
Currants (dry)	27.9	1.2	64.0	2.2	1.7		74.5
Raisins	14.0	2.5	74.7	4.1			88.2
Olives	67.0	2.5	5.7	4.4	3.3		9.4
Tomatoes	94.3	.7	3.7	.4	.5	0.58	5.0

Fruit Acids.

The acids found in fruits are malic, citric and tartaric. These acids are carbohydrates and like starch and sugar are burned in the body, having a fuel value of about half that of sugar. Fruit acids are found in foods in combination with soda or potash, usually the latter. When taken into the body, the acid parts are oxidized or burned, leaving the base, or alkali, behind. On this account, the effect of these food acids is to increase the alkalinity of the fluids of the body, a matter of much consequence since by this means the acid waste products of the body are neutralized, and the tendency to acidosis always present is overcome. Citric acid and malic acid appear to be the most easily burned or utilized by the tissues. Tartaric acid is less readily utilized.

Citric and malic acids are the common acids of fruits, the last named being most abundant except in berries and in fruits of the citrus family, in which citric acid predominates. Grapes contain tartaric acid only when ripe, the malic acid present in green grapes being changed to tartaric acid in the process of ripening. Apples and cherries contain malic acid chiefly. Cranberries contain .05 per cent of benzoic acid, which is also present in plums and prunes. Citric acid is found in tomatoes.

Many people have noticed the marked benefit from the use of acid fruits. The writer has not infrequently been told by persons suffering from dyspeptic disorders that the juice of a lemon taken soon after meals has sometimes given relief. Others have been benefited by apple juice and others by moderately acid fruits of other sorts.

The nature of this beneficial effect of fruit was not understood until explained by experiments by Pavlov and others, which demonstrated: first, that the acids of fruits stimulate the stomach to produce gastric acid, which is absolutely essential for good digestion; and second, that the acids of fruits are able, to some degree, to take the place of the natural acid of the stomach when this acid is absent.

These facts emphasize the importance of acid fruits, including the tomato—a vegetable-fruit—as an aid to digestion in achylia, a condition in which there is deficiency or absence of hydrochloric acid, the normal acid of the gastric juice.

Disinfection of Fruits.

Raw fruits and vegetables as received from the market are always open to suspicion of being contaminated with bacteria. In fact, this is true of most raw foodstuffs. All kinds of fresh fruits are infected with germs, yeasts and molds, which speedily develop and destroy the fruit unless prevented from so doing by means of cold storage. These germs may be derived from the garden soil, the hands of the pickers, the receptacles in which they are transported, or the markets where they are exposed for sale. In the summer time the germs grow rapidly while the fruit is being transported to market, or while exposed in the market, or even after purchase by the consumer. Flies are a common source of infection.

Thus fruit, eaten without disinfection, may easily become a source of mischief, as germs may grow in the stomach or intestine when swallowed with the food. In this way the average individual is constantly collecting germs of various sorts and every adult carries in his colon a vast assemblage of bacteria, the so-called intestinal flora.

Such vegetables as lettuce, celery, and radishes, and fruits which like strawberries, grow in, on or near the ground, are liable to carry not only germs but the embryos of various intestinal parasites.

The use as fertilizer, of "night soil," gathered by city scavengers and largely disposed of to gardeners in the neighborhood of large cities, very naturally facilitates the distribution of intestinal parasites of various sorts. Some years ago, Metchnikoff called attention to the danger of infection from this source.

The late Ellen H. Richards, of the Massachusetts Institute of Technology, made some years ago a study of the condition of fruit found on open air fruit stands. A pint of fruits taken at random from a stand were washed and a bacteriological examination made of the washings. 140,000,000 germs were obtained from this single pint of fruit. Fruit thus exposed to street dust is certain to collect a great number of germs derived from the excreta of animals and other dangerous sources and is quite unfit for food.

Snails, worms and insects gather typhoid and other germs from the soil and in crawling over the leaves of vegetables deposit a trail of germs with fecal matters upon the surfaces which they traverse.

A fresh chloride of lime solution, half ounce to a gallon will destroy the germs without impairment of the food in flavor or any other particular. A large stone jar is half filled with the solution, one part to twenty of water. Fruit, lettuce, or other food, after thorough washing, is immersed in the disinfectant and allowed to remain for five minutes. The solution should be kept covered and will be effective for several days.

At the Battle Creek Sanitarium, this method is in daily use for the disinfection of all fresh, uncooked fruits and vegetables used in the feeding of the great family of 2,000 to 3,000 persons who are served in the several capacious dining rooms of the institution.

Since this practice was introduced about 20 years ago, outbreaks of "bowel trouble," which formerly occurred with considerable frequency during the summer months, have wholly ceased.

This practice of disinfecting all fresh foods will no doubt in time become general. It is the only means of protection against certain intestinal parasites which are very difficult to dislodge after they once become established in the intestine.

Fruit Seeds.

The seeds of fruit consist chiefly of cellulose. Small seeds such as are found in figs, blue berries, raspberries and most other seedy fruits are entirely harmless and are perhaps to some degree beneficial through increasing the bulk of the food. Large seeds, as those of the apple or grape and the cherry if taken in considerable quantity might prove burdensome to the intestine and on this account ought to be discarded. It should be mentioned, however, that the danger which many people apprehend from the entrance of these seeds into the appendix is largely imaginary. Seeds are sometimes found in a diseased appendix, but their presence is purely accidental; they are not the cause of the disease but a consequence of it. When the appendix becomes diseased in such a way that the valve which guards its mouth no longer operates, remaining open, seeds and other foreign bodies may find their way into the appendix and possibly may thus become a source of injury and danger although the danger from this source must be quite remote.

The Fruit Diet.

By making a proper selection of fruits it is possible to construct a dietary quite capable of sustaining life for an indefinite period. Bananas, figs, dates, raisins and prunes contain an abundance of nutritive material in sufficiently concentrated form to be readily available as suitable foodstuffs. The only element lacking is fats and these may be readily obtained from such fruits as the avocado or alligator pear of the tropics and by the addition of nuts to the bill of fare. By a combination of fruits and nuts a very complete and luxurious bill of fare may be provided.

For entire safety, however, it is better to add milk to the above bill of fare. A pint of milk a day will insure the proper intake of food lime and of the complete proteins which are necessary for the repair of the blood and of the tissues.

Contrary to the opinion formerly held by physicians, fruits and fruit juices are not only not injurious to persons suffering from gouty or rheumatic affections, and even in cases of acidosis, but are highly beneficial.

Fruit juices of all sorts contain in addition to vegetable acids, alkaline substances which neutralize acids and aid in the elimination of uric acid. Pure uric acid dissolves with great difficulty but the urate of soda or potash is readily soluble. Soda and potash are present in fruits in considerable quantities in combination with other acids. When fruit is eaten the acids are utilized or burned in the body leaving the soda behind. It combines with the uric acid and thus aids its elimination. The popular idea that the acids of fruits are unwholesome for persons suffering from gout and other uric acid disorders is a very mischievous error. The fallacy of this teaching has been pointed out for many years by scientific writers on dietetics, but like many other popular fallacies this erroneous notion is very hard to eradicate.

The Germicidal Properties of Fruits.

More than twenty years ago Kitasato and Van Ermengen demonstrated experimentally that citric acid and other fruit acids are possessed of active germicidal properties. The typhoid bacillus and also the bacillus of cholera were destroyed by a one-half per cent solution of citric acid. Malic acid, the acid of the apple, was found equally efficient. In making a direct application of this discovery, the writer succeeded in sterilizing the stomach of a patient, a physician, whose stomach fluid showed more than five million aerobes and two and one-half million anerobes per cubic centimeter. The stomach was found completely sterile after a meal consisting of ten ounces of strawberries and nine ounces of water. Half a pint of orange juice given half an hour before the meal has been found of very great value in similar cases. The idea of using fruit juices in cases of gastro-intestinal autointoxication is, however, by no means new.

Dr. Dwight more than a century ago reported cases of sick headache successfully treated by giving the patient a glassful of apple cider before each meal.

The character of the food certainly makes a very marked difference in cases of this sort. For example, in the case of a meal consisting of scraped beef prepared and cooked in the usual way bacteriological examination of the stomach fluid showed nearly 24,000,000 bacteria per ounce, although after a sterile meal no bacteria at all were found. In the same case a test meal of cheese gave 280,000,000 bacteria to the ounce of stomach fluid. These observations led the writer many years ago to adopt in the treatment of cases of gastrointestinal disease a strict antiseptic or rather an antitoxic or atoxic dietary, from which meat and eggs are wholly excluded.

Later, after many experimental efforts, the fruit regimen was devised. In this diet fruit is made the exclusive food with bran in liberal quantities, as explained in detail elsewhere. This regimen has proved to be of great service in the treatment of constipation (p. 532).

The Iron Content of Fruits.

We are so accustomed to think of fruits solely as sources of sugars and acids that we are naturally surprised at the discovery that these choice comestibles are really most valuable sources of food iron. It is true the average iron content per ounce is small, less than two per cent of the daily ration (1.74); but then the food value is also low on account of the large percentage of water, so that the average *per cent.* of the ration of iron is more than three times as great (5.6). One can eat a larger bulk of fruit without risk of injury than of any other class of foodstuffs.

Besides, there are certain fruits which are exceptionally rich in iron, containing on the average twice as much iron as the general run of fruits. Of less than a half dozen fruits in this class, dates, figs, Zante currants, prunes and raisins, the average per cent of the day's ration per ounce is 5.2 and per 100 calories 6.8, considerably higher than the averages for all foodstuffs which are respectively per ounce, 3.25 and per 100 calories 6.38.

It will be readily seen how the fruits named may be usefully employed in balancing the ration for iron. A quarter of a pound of dates supplies nearly one-fourth of a total day's iron ration, and at the same time, furnishes a substantial amount of energy to support muscular work. Two ounces each of figs, olives and prunes, and an ounce each of raisins, dates and currants would supply half a day's requirement of iron and one-third of a liberal day's food supply.

Taking into account the large amounts which may be eaten with impunity, together with their other good qualities, fruits may well be regarded as a most valuable source of food iron. The strawberry and the raspberry are especially noteworthy.

The Lime Content of Fruits.

A characteristic of fruits in general is their small lime content. The average amount of lime in 28 of our commonly used fruits is one-eighth grain per ounce, requiring 123 ounces for one day's supply of lime (15.4 grains), more than is demanded of any other class of foods with the exception of meats which require the consumption of 270 ounces, more than 17 pounds, an impossible amount for anyone but an Eskimo.

It is important to observe, however, that there are some very noteworthy exceptions to the general rule of low lime content in fruits. Zante currants are rich in lime, containing half a grain to the ounce, or four times as much as the average of all fruits. The olive affords three-quarters of a grain to the ounce and the fig, which has been a choice food staple for millions in the Orient from remote ages, supplies a whole grain of lime to each ounce, or a day's lime ration in less than one pound of the dried fruit, and one-third as much in the same quantity of figs fresh from the tree.

Fruits are thus seen to be a really practical means for replenishing as well as maintaining the lime supply of the body, a need which our ordinary bills of fare wholly ignore.

And fruits have the advantage not only of being a most agreeable form of aliment, but a most reliable source of lime, since they are not likely to be robbed of their mineral constituents by the misguided efforts of those experts in denaturing and sophisticating foodstuffs, the manufacturers, canners and cooks.

It is well to note the fact that quite a number of our most commonly used fruits are very deficient in lime salts. For example, the apple contains so little lime that one would have to eat 22 pounds daily to get his supply if dependent on this source alone. The banana is almost equally deficient, requiring 17 pounds for a day's ration. The tomato yields a day's supply in 14 pounds, the watermelon in an equal quantity, the pear and the peach in 10 pounds and the cantaloup in 9 pounds. In other words, the proportion of lime in these fruits is so small that it may be ignored in estimating the lime content of bills of fare.

The Ripening Process in Fruits.

In Mexico, ripe fruit is said to have been cooked in the sun (cocido in el Sol). The Arabs have a similar saying. The changes which take place in the cooking of green fruit are much the same as those which occur during ripening, though much less extensive. Cooking renders green fruit digestible, and ripening does the same, but also involves many other changes. The Experiment Station Record tells us that "the apple fruit, considered as a living organism, has first a period of growth during which the dry matter, principally starch, is continually increased. A second, or ripening, period follows, during which starch is changed into sucrose (cane sugar). This in turn is gradually changed into invert sugar, with a gradual decrease of malic acid and of carbohydrates and an accompanying respiration of carbon dioxid. These changes are largely due to the activity of oxidizing enzymes, the oxygen of the air being drawn upon in the process.

"The changes progress much more rapidly after picking, at high temperatures, and in the short-season varieties. Soon after picking, apples should be placed in cool storage to retard the processes above mentioned. Respiration continues during the storage period, becoming ultimately less active. Transpiration continues during the life of the apple. The third period is that of disintegration."

Arsenic in Fruit.

The extensive use of arsenic for the spraying of fruit trees has led to an investigation of the possibility of contamination of the fruit with this poisonous chemical. Careful analyses have shown that spotted apples often contain considerable quantities of arsenic. As much as three-tenths of a milligram, nearly one two-hundredth of a grain, of arsenic has been found in a single apple. Arsenic has also been found in the paper with which apples are wrapped. This is a matter which should receive serious attention by apple growers and shippers.

THE APPLE

The apple tree thrives in all temperate regions along with the oak, and has been known and appreciated from prehistoric ages. There are about fifteen hundred cultivated varieties of the apple, but of this great number not more than fifty are of commercial importance.

The apple contains about one-seventh its weight of solids, of which the chief part is sugar and protein. The acid of apples is chiefly malic, the percentage of which varies greatly in different varieties of this valuable fruit.

	Per Cent. of Acid (Malic)
Baldwins	.60
Maiden Blush (Green)	1.68
Early Ripe (Green)	1.09
Gravenstein (Green)	1.27
Sweet Bough (Green)	.21
Sweet Bough (Ripe)	.13
Sour Apples	.62
Tompkins King	.41
Crab Apple	.78
Northfield Beauty Crab	1.81
Sweet Cider	.40-.56

The presence of pectin gives to the juice of apples the property of jellying when concentrated by heat.

Apples and apple juice are of great dietetic value. Taken freely they are laxative, especially when taken on an empty stomach.

The apple is a universal favorite as a luxury, and is by no means of small value as a food. Its fine flavor and appetizing acid gives it preeminence as a peptic stimulant. Recent observations in feeding experiments seem to indicate that its protein, though small in amount, is particularly fine in quality.

As is true of other fruits, some persons are sensitized to the protein of apples and cannot even endure their presence, although such cases are rare. One such example is mentioned by Soyer who relates that Ulaislas, King of Poland, in the presence of apples became so distressed and terrified that he was compelled to flee, a circumstance which at that time was most mysterious and unaccountable on rational grounds.

Two of our most excellent apples, the Baldwin and the McIntosh Red, were found growing wild in the woods. Appropriate monuments have been erected to the originals of these noble fruits.

Apple Juice.

Unfermented apple juice is exceedingly wholesome. The agreeable acid flavor is due to malic acid, which is an excellent antiseptic or disinfectant for the stomach and intestine. It is a very highly valuable remedy in gastric and intestinal catarrh, so-called biliousness, jaundice, constipation, and in cases in which the kidneys and the liver are disordered; in emaciation, loss of appetite, and general malnutrition. It may be taken in quantities of one quart daily with advantage. The best times for taking are one-half hour before each meal and just before retiring at night.

Freshly prepared apple juice is one of the best of all fruit juices and is even superior to grape juice. Malic acid is a milder acid than the tartaric acid of grapes, and is more easily utilized by the body. Freely used, apple juice is a laxative and combats any tendency to acidosis. Persons subject to gout and other disorders due to chronic uric acid poisoning, may make a liberal use of apple juice to advantage.

Apple juice should be prepared from selected apples, which should be thoroughly washed before grinding. The juice may be preserved by heating to a temperature of 165° F. for fifteen or twenty minutes. This will kill the yeast and other organisms which give rise to fermentation. Heating to a high temperature impairs the flavor of the juice, while lessening its wholesomeness.

The common practice of adding a small percentage of benzoic acid to apple juice to prevent fermentation is highly objectionable and cannot be too strongly condemned.

THE PEAR

The pear, at its best, is a most delectable product of Nature's food laboratory. It is a sweet fruit, containing less acid than almost any other fruit. The following table shows the small amount of acid found in those varieties which contain the most:

	Acid (Malic)
Kieffer	.50
LeConte	.28
Bartlett	.30
Angonleme	.18
Seckel	.06-.20
Winter Nelis	.11-.25

THE QUINCE

The quince, like the apple, has come down to us from the ancients. Its flesh is too hard for use in a raw state, and is chiefly employed for marmalade and preserves.

THE PEACH

In its best state, the peach is one of the most delicious of all our orchard fruits. The finest varieties are rich in sugar (6 per cent) and contain little acid. This fruit, even when ripe, contains considerable cellulose and thus is valued as a laxative.

The nectarine is a variety of the peach which has a smooth skin.

The apricot is another member of the peach family. It differs from the peach in containing about twice the amount of sugar and still less acid.

PRUNES AND PLUMS

Of these fruits there are many varieties, some of which are sweet, while others contain a considerable amount of acid. The prune when dried is nearly as rich in sugar as the fig.

Prunes soaked in water for twenty-four to forty-eight hours and freely eaten have a decided laxative effect. Prunes are much used for this purpose by eminent German physicians.

A research conducted by Dr. Blatherwick of the Sheffield Scientific School of Yale University, some years ago in the laboratory of the Battle Creek Sanitarium, showed that prunes contain so large an amount of unusable acid that they tend to acidify the urine. This acidity was later found to be due to benzoic acid. This is the only possible objection to their use. When eaten in connection with fresh vegetables in liberal quantities this objection would probably not hold good as the small amount of benzoic acid would be neutralized; but if eaten freely in connection with a cereal diet, the urine might be rendered so highly acid as to be decidedly injurious in some cases, especially in cases in which the bladder or kidneys are diseased.

Prunes and plums should be avoided in cases of irritable bladder and whenever there is a tendency to acidosis.

THE CHERRY

The cherry is one of the most highly valuable of our orchard fruits, and is much appreciated because of its early appearance. It contains more than 10 per cent of sugar, and has a nutritive value higher than that of the apple.

"According to Pliny," says Fernie, "cherries were first brought to Rome by Lucullus after his great victory over Mithridates, 89 B. C. The cultivated cherry disappeared in this country (England) during the Saxon period, and was not re-introduced until the reign of Henry the Eighth.

"Cherry stones have been found in the primitive lake dwellings of Western Switzerland. There is a tradition that Christ gave a cherry to St. Peter, admonishing him not to despise little things.

"In France, soup made from cherries and taken with bread, is the common sustenance of the wood-cutters and charcoal burners of the forest during the winter."

The cherry is one of the most nutritious of the tree fruits. Some varieties are very rich in sugar, while others present a large per cent. of citric acid. Its iron content is greater than that of egg white, milk, pears, and apples, and equal to that of the tomato.

THE PERSIMMON

The native persimmon, which grows wild in the South and occasionally occurs as far North as Michigan, is a very sweet and palatable fruit when fully ripe. The Japanese variety is much larger than the American, and is a very luscious and wholesome fruit.

THE OLIVE

This is another very ancient fruit, now produced extensively in this country, particularly in California. As picked from the trees, the olive is exceedingly bitter in taste. The bitter flavor is removed by immersion in running water for several weeks, or by placing for some hours in an alkaline solution.

Green, pickled olives are inferior in food value. The ripe olive is highly nourishing. It is chiefly sold in this country in bottles or cans, being preserved by heating like other canned fruit. A few cases of poisoning have occurred from the use of olives infected with the *B. botulinus,* which gives rise to botulism, a serious, sometimes fatal, form of food poisoning. Canned olives which have an unpleasant odor when opened, should be rejected. Poisoning is not likely to occur from the use of olives canned in tin.

The olive is usually eaten in the ripe state in Oriental lands where this oleaginous fruit is at home. In this country, however, the green olive has been the general favorite as a relish until recent years have seen the beginning of a change in the taste of the American public and the ripe olive is now growing in favor as it well deserves to do. The green olive is practically indigestible, while the ripe olive is, on the other hand, both easily digestible and highly nourishing.

According to Gautier the green olive contains little fat, but much mannite and chlorophyl which in the process of ripening is converted into fat.

	Green Olive (Gautier)	Ripe Olive (Atwater)
Water	73.40	64.7
Protein	.76	1.7
Fat	14.48	21.0
Extractives	8.04	3.5
Cellulose	.90	
Ash	.42	2.7

The *Scientific American Monthly* gives us the following interesting information concerning the production of ripe olives:

"Most of our ripe olives originate in California where three pickings are made during the season in order to obtain fruit of equal ripeness. At the factory the fruit is first sorted, graded for size, and is then placed in an alkaline solution, usually sodium hydrate, the strength of which varies, but probably averages one and one-half per cent. At the end of six to eight hours this lye is drawn off, the olives exposed to the air to brown them by oxidation, and the operation repeated until an examination shows that the lye has penetrated to the pit. Clear water changed twice daily is now used until the lye and bitterness are removed, this requiring from four to eight days. The next treatment consists of a series of brine solutions, beginning with one per cent and increasing the strength at intervals of about two days until approximately four per cent is used. At this point they are ready to be put into glass cans and sealed.

"Some packers allow the olive to remain in the weak brine long enough to produce an acid flavor by fermentation and others endeavor to retain the natural color rather than to induce oxidation. If it is intended to hold the olives in bulk the strength of the brine is increased until ten or twelve and one-half per cent is reached, the stronger solutions being necessary if they are to be carried through the summer.

"To be sure the process as outlined is modified in practice to satisfy the conditions, taking into consideration varieties of fruit, temperature, etc. As the olives are packed the soft and defective ones are discarded and the containers are filled with three per cent brine at a temperature of 175° or 180° F. The air is then exhausted while the temperature is raised to 185° when the containers are sealed ready for processing. Processing consists in cooking in the bottle from fifty to sixty minutes, depending upon the size of the olive and the size of the container. 240° F. is reached in some factories. If a lower temperature is used the time is increased."

THE GRAPE

The grape is one of the most valuable of fruits and has been in use for ages. When partially ripe, the grape contains both tartaric and malic acids, but the malic acid is changed to tartaric as the process of ripening continues.

The different varieties differ in sweetness, the sugar content varying from 13-25 per cent. The acid content also varies in the different varieties.

Zante currants are prepared from the Corinth grape, a small black variety which has a thick skin and is seedless.

Grape Juice.

Grape juice has now become a very extensive article of commerce. It is preserved by bottling and pasteurizing. In Oriental countries, the juice of sweet grapes is concentrated in the sun to the consistency of syrup. This is highly prized as an article of diet throughout the Orient. This grape syrup has been in use from the most remote times.

The Composition of Grape Juices.

The following table shows the amount of tartaric acid and other solids found in commercial grape juices, the solids consisting almost wholly of levulose and dextrose, the sugar added for sweetening having been inverted by the acids present:

	Solids	Tartaric Acid
Welch's	19.00	1.00
Armour's Top Notch	14.51	0.93
Duff's	15.37	1.07
Fremont	13.99	1.08
Liggett's	15.13	0.86

The above analyses, with the exception of Welch's grape juice, were made by the Canadian Inland Revenue Department.

BERRIES

The characteristic of the berry is its seedy pulp. The seeds are indigestible, but of value as roughage.

The acid of berries is chiefly citric acid, with a small amount of malic acid.

Of the dozen or more edible berries which grow wild or in cultivation, scarcely half a dozen are in such general use as to be important commercially.

The Strawberry.

The strawberry, with its delicious aroma and its delicate sweet-acid flavor, is one of our choicest and most popular fruits. It is at the same time a highly useful and wholesome food. Its high water content reduces its nutritive value below that of most fruits, placing it on a footing with the orange, the muskmelon, string beans and turnips; but it is unusually rich in lime and iron, not only as compared with other fruits, but with most other foodstuffs. Here are a few interesting comparisons:

The strawberry contains one-fourth grain of food lime to the ounce, which is more than any other fresh fruits except fresh figs and raspberries. Its lime content is six times as great as that of the apple, five times the banana, four times the tomato and watermelon, and double or more that of the blackberry, blueberry, cherry, cranberry, grape, muskmelon, peach, pear, pineapple or plum. Its lime content is greatly excelled among fruits only by dried fruits, especially figs, dates, currants, raisins and prunes.

The strawberry presents a higher proportion of lime, notwithstanding its high water content, than any cereal food except oatmeal and entire wheat and rye. It affords, in equal weight, five times as much lime as does rice, four times as much as hominy, and three times as much as white bread.

Egg white, which is very rich in food lime, contains only twice as much as does the strawberry; and strange as it may appear, this delicious fruit affords three times as much lime as does white of egg and four times as much as beef or chicken.

The richness of the strawberry in iron is still more noteworthy. With the exception of the raspberry and fresh figs, the strawberry excels all other fresh fruits in richness in food iron. It contains four times as much iron as does the orange and nearly three times as much as the grapefruit, apples, apricots, cantaloup, muskmelon, grapes, peaches, pears or watermelon; twice as much as do tomatoes and cherries, and fifty per cent. more than raspberries, currants, cranberries, bananas and blackberries.

A pint of strawberries contains as much food iron as a pound loaf of white bread and one-fourth more than an equal weight of cornmeal.

Strawberries are richer in iron than most fresh vegetables, affording more than celery and lettuce, as much as sweet corn, cauliflower and cabbage, only a little less than string beans, cabbage and brussels sprouts, and one-half more than turnips, squash, radishes, eggplant, carrots, parsnips, beets, onions, and sweet potatoes, and four times as much as cucumbers. It is only excelled as a source of food iron by two vegetables—fresh lima beans and green peas. The strawberry has great value, when freely used, as a protection against the loss of lime or of iron, and it is also invaluable as a source of organic bases which are needed to neutralize the acid wastes of the tissues, thus preventing the development of "acidosis" and its numerous accompanying evils.

This excellent fruit contains 7 per cent. of sugar and 1½ per cent. of acid, chiefly citric.

Walton in his "Complete Angler" quotes Dr. Boteler as saying, "Doubtless God Almighty could have made a better berry, but He never did." And most people will agree with the doctor in his opinion.

The strawberry is a hardy plant and thrives in the far North. The Laplanders mix the berries with reindeer cream and dry in the form of a sausage for use during their long winter. The liberal use of fresh strawberries has been found an excellent remedy for sprue and pellagra.

The Currant and the Gooseberry are two excellent berries rich in both sugar and acid, which is for the most part citric.

The Cranberry.

This very popular berry contains about 4 per cent of sugar and half as much acid, including one-twentieth of 1 per cent of benzoic acid, the balance being citric acid.

The cranberry should be avoided by persons who have a tendency to acidosis or highly acid urine.

The Huckleberry or Blueberry.

This excellent fruit flourishes in a wild state over a large territory extending from the Southern states to the far North. Recent and very successful attempts have been made to cultivate the blueberry in Florida and elsewhere. The blueberry is one of the most laxative of berries on account of the very large amount of cellulose found in its thick skin and numerous seeds.

The Blackberry and the Loganberry.

The blackberry is a richly flavored fruit containing a little less than 2¼ per cent of sugar and 5 per cent of cellulose, which gives it laxative properties. It grows wild in great quantities in certain parts of the country. Cultivated varieties are larger and finer in appearance, but not superior in flavor to the wild berry, which is much sweeter than the cultivated.

The loganberry is simply a red blackberry, a sport.

Commercial loganberry juice consists of the pure juice of the loganberry with the addition of cane sugar. A pint of loganberry juice contains about six ounces of cane sugar and a quarter of an ounce of fruit acids, of which three-fourths is citric acid, the remainder malic acid.

The following is the composition of loganberry juice, according to an analysis made by the Columbus Laboratory of Chicago:

Solids	34.25
Reducing sugars, invert	16.10
Cane sugar	14.80
Citric acid	1.32
Malic acid	0.47
Pectose, color, etc.	1.07
Protein	0.20
Ash	0.29

The Raspberry, now produced in many varieties, is somewhat finer in flavor than the blackberry. It contains a little more sugar and less acid than the blackberry.

THE MULBERRY

This fruit, though highly palatable and rich in sugar, is little used in this country, but in Daghestan is highly prized for its richness in sugar. The dried Daghestan mulberry is so sweet it melts in the mouth like a small lump of sugar.

Wild Berries.

The numerous berries which grow wild are worthy of larger consideration than they have heretofore had in the national dietary. They are particularly valuable because of their richness in vitamins and the large amount of cellulose, which gives them laxative properties which are almost universally needed. Among the best of these may be enumerated the whortleberry, blackberry, barberry, raspberry, dewberry, cranberry, and strawberry, which is the queen of them all. The elderberry, service berry, cloud berry and the June berry are also worthy of mention.

CITRUS FRUITS

The Orange.

The orange is one of Nature's finest gifts to man. Orange juice contains pre-digested food in a most delicious and attractive form, ready for immediate absorption and utilization.

The amount of food contained in a single large orange is about equivalent to that found in a half slice of bread, but it differs from bread in that it needs no digestion, while bread, before it can be used in energizing and strengthening the body, must undergo digestion for several hours. It is for this reason that oranges are so refreshing to an exhausted or feeble person. The sweeter the orange, the greater its food value.

A pint of buttermilk has a food value of 176 calories, one-fourth less than that of an equal quantity of orange juice. A pint of oysters affords the same number of food units as a pint of buttermilk and hence has a food value inferior to that of orange juice. Even full milk is not so much superior to orange juice in nutritive value as one might expect. A pint of orange juice contains nearly the same number of food units as three-fourths of a pint of milk. Numerous green vegetables have a nutritive value no greater than that of orange juice.

But the energy value of the orange, which for an ordinary sized orange amounts to 75 to 100 calories, is by no means its only value. Orange juice is rich in salts, especially in lime and alkaline salts, which counteract the tendency to acidosis that is always threatening sedentary people, hearty meat eaters, and those advanced in age. The free use of orange juice is a valuable means of combating the inroads of "Father Time," and is also an excellent means of antidoting, to some extent, the bad effects of an indoor or sedentary life.

One or two oranges taken at bedtime and on rising in the morning are an excellent means of stimulating bowel action. Oranges may be taken between meals with great benefit by feeble persons and those suffering from constipation. The delightful flavor and general stimulating influence of orange juice excites peristaltic activity, and so tends to prevent the accumulation of food residues in the colon which leads to putrefaction and auto-intoxication.

As a food in fever cases, nothing could be more perfectly suited to the requirements of the patient's condition. The fever patient needs water to carry off poisons which are burning him up and against which his cells and organs are struggling. Four to six quarts of water are needed daily to quench the fever's fires and aid elimination through the skin and kidneys.

The grateful acids furnish aid in satisfying thirst, and the agreeable flavor makes it possible for the patient to swallow the amount needed. The intense toxemia from which the fever patient suffers coats his tongue and often destroys his thirst for water as well as his desire for food. The agreeable flavor of orange juice aids greatly in overcoming this obstacle.

Another special and valuable property of orange juice is the small amount of protein or albuminous matter which it contains. Fever patients have little gastric juice and very small digestive power, and so need to take food which is ready for absorption and immediate use. Foods poor in albumen are also needful in fevers because they do not leave residues to undergo putrefaction in the colon, as do meat, eggs and numerous other foods.

Orange juice contains less than one per cent of protein or albumin so that a patient may take three or four quarts of the juice without getting an excess of protein which might easily become a source of great injury.

Two quarts of orange juice with an equal amount of barley, oatmeal or rice gruel makes an ideal daily ration for a patient battling with typhoid fever.

Another class of cases in which orange juice is almost indispensable is found in those most unfortunate and suffering of mortals—bottle fed babies. Usually fed on pasteurized or sterilized milk, these unhappy little ones seldom fail to show marked evidence of malnutrition. They are, indeed, not infrequently victims of scurvy, rickets or pellagra. The investigations of Funk, McCollum and many others have shown that the emaciation, weakness, arrest of growth and general malnutrition in such cases is due to absence from their food of the essential known as vitamin.

A few years ago the fortunate discovery was made that orange juice contains elements capable of supplementing the diet of puny, bottle-fed babies, resulting in immediate resumption of growth and a speedy return to health. This remarkable transformation occurs not only in human infants, but in young animals upon whom the orange juice feeding experiment has been repeated.

Every infant fed on sterilized milk or artificial infant foods; in fact, every infant fed from a nursing bottle *not doing well* should receive daily half an ounce to two ounces of orange juice, according to age, to supply necessary vitamins. Older children not doing well should receive two to four ounces of orange or tomato juice daily.

The acid of orange juice and the sugars it contains aid digestion by stimulating the gastric glands to increased activity. It is also an appetizer of the first quality.

On the whole, oranges are probably capable of serving more useful purposes in the economy of the body than any other juicy fruit. As people become better educated in dietetics, oranges will be more and more appreciated and more freely used.

The Lemon.

There are more than sixty varieties of the lemon, including the lime and sweet lemon. Formerly, the best lemons came from Sicily, but at the present time the finest lemons grown are produced in the United States. In Southern California and Florida, the enterprise of American horticulturists has brought the fruit and its culture and handling to a very high state of perfection.

The lemon rind contains an essential oil which is useful for some purposes, especially for flavoring, but the real value of the fruit is found in the two ounces of acid juice which the average lemon contains.

The composition of lemon juice varies considerably, according to the time of picking and the length of time the fruit has been kept, together with the manner of keeping. The chief constituent of lemon juice is citric acid, of which the average lemon contains about 7.5 per cent. A lemon picked in April contains only about two-thirds as much acid as one picked in November. From April on, the percentage of acid steadily diminishes until by July there is little left, the citric acid being converted into sugar (dextrose) and carbondioxide. This is due to the vital activities of the living cells of the fruit. If oxygen is excluded, by varnishing the fruit, the change may be prevented, as also to a large extent, by cold storage.

Lemon juice also contains a notable amount of "salts" (two to three per cent) chiefly potash and phosphoric acid.

The percentage of potassium in lemon juice is greater than in either apple juice or grape juice. This abundant and unusual supply of "salts" makes the lemon an important source of this highly essential food principle, and brings clearly to view the fact that the nutritive effect of lemon juice is that of an alkali instead of that of an acid, as superficial knowledge would suggest.

It thus appears that the lemon is worthy of a much larger place in our national dietary than it has heretofore enjoyed.

All fruits are valuable as a means of counteracting the tendency to excessive accumulation of acids through the large use of cereal breakfast foods and excessive meat consumption, which are current practices in this country; but the lemon has the advantage that it is accessible at all seasons of the year. It may be readily obtained when most other fruits are difficult to procure.

But the claim of the lemon to a prominent place in the national dietary does not rest alone upon its valuable store of alkaline salts. It has long been known that the juice of lemons contains something of such extraordinary value as a food that without it the diet of soldiers, seamen, and other bodies of men who are compelled to live for long periods of time upon a restricted diet, is almost certain to prove so inadequate as to give rise to very grave and often fatal disease. Outbreaks of scurvy, especially among soldiers and sailors, have been recognized for hundreds of years.

The lemon, of all fruits, seems to possess the highest scurvy-preventing value. It was formerly thought that the sour lime of the West Indies was especially valuable for this purpose, but Alice Henderson Smith has demonstrated that the West India sour lime has only one-fourth the scurvy-preventing value of the lemon. This observer has also proven that the so-called lime juice used many years ago as a preventive remedy, was prepared from lemons and sweet limes, and not from the sour lime. This property of the lemon is found to be due to a subtle substance present in lemon juice in minute quantities, known as the antiscorburic vitamin. This vitamin is also found in many fresh fruits and vegetables, particularly in the tomato and the potato, but the juice of the lemon and of the orange, especially that of the former fruit, has been shown, not only by clinical experience but by crucial laboratory experiments, to possess this property in a very high degree. This property is not associated with the acid of the lemon, for it is found to be present even after the acids have been removed, and is not possessed by the citric acid of the laboratory, which may be purchased at drug stores in crystalline form.

It is believed by observing medical men that scurvy in mild and obscure forms is very widely prevalent in this country and probably in all civilized countries.

The conventional breakfast, consisting of coffee, white bread or toast, bacon or griddle cakes with syrup, and, perhaps the addition of pickles or doughnuts, is almost altogether deficient in vitamins, and is an excellent formula for producing scurvy.

The substitution of lemon squash or hot lemonade for tea or coffee, or even any of the various cereal substitutes for coffee, would initiate marvelous physical improvement in thousands of families which are now languishing under various forms of malnutrition.

Lemon juice should be universally substituted for vinegar as an acid flavoring for salads and other vegetable dishes. It has long been used for this purpose by the best French cooks, and for many years has been gaining in favor in this country.

As an appetizer, lemon juice has no superior. It stimulates the flow of saliva, and in like manner causes the gastric glands to pour forth the gastric juice which both disinfects and digests the food.

Lemonade prepared by the addition of the juice of one small lemon to a quart of water, with three or four ounces of malt sugar, is an excellent beverage for use in fevers. Two or three quarts may be given daily with advantage.

Lemonade may be freely used in rheumatic fever as well as other fevers, since the potash salts present serve to alkalinize the blood and other tissue fluids, as already explained.

The Lime.

This citrus fruit, allied to the lemon, possesses a characteristic flavor much liked by most persons, but on the whole ranks below the lemon in dietetic value, especially because less active as an antiscorbutic.

TROPICAL FRUITS

There are many tropical fruits which, with our improved methods of transportation, will probably in time become as popular in the United States as they are in the Central American countries. The mango and the avocado, or alligator pear, and the various varieties of the sapota are excellent fruits which might be added to the rather limited list of fruits grown in the United States.

The Banana.

A native of Asia, the banana is now grown in most tropical countries, and is one of the most productive of all food plants. Its food value is a little greater than that of the potato. Its protein content is small, one and a half calories to the ounce. It also contains very little fat. When ripe, it affords a large amount, more than 25 calories to the ounce, of an easily digestible carbohydrate.

The popular idea that the banana is difficult of digestion is the result of the use of the fruit in an immature state. The banana is never allowed to ripen on the plant which produces it. It is always picked when it has attained full size but is not yet mature. The fruit is not fully ripe until the skin has become, in part at least, brown in color. During the change from yellow or red to brown, the starch, of which the green banana contains a large amount, is converted into dextrin and sugar, of which the ripe banana contains nearly 25 per cent. When thoroughly ripe, the banana is one of the most easily digestible of foods. When to be eaten by invalids or infants, it is well to convert the pulp into a purée by passing through a colander, after which it may be rendered very palatable and inviting to the eye by beating with an egg beater.

The banana has a higher nutritive value than almost any other fruit which can be eaten fresh. Pound for pound, it supplies as much nutriment as the potato and is the staple food for thousands of rubber gatherers who perform prodigious feats of muscular exertion and endurance with almost no other sustenance.

A well ripened banana contains almost no raw starch. Myer and Rose report that when bananas not well ripened are eaten, a considerable amount of starch is found in the stools. This fact emphasizes the importance of taking care to select well ripened fruit, as indicated by the dark brown color of the skin, especially when feeding bananas to children.

The banana is rather deficient in organic salts; hence its digestion and assimilation leaves little residue to be eliminated by the kidneys, a fact which may be taken advantage of in the feeding of patients suffering from Bright's disease. Cases of this sort have been found to do well on a diet consisting largely of bananas.

Humboldt first called attention to the enormous amount of food which may be produced by a single acre of bananas. Competent authorities have estimated that the banana yields per acre three or four times as much food material as is produced on the average by wheat, potatoes, or corn.

Banana Flour.

Banana flour is made by drying and grinding the mature but unripe fruit, the starch of which has not yet been changed to sugar. Banana flour is an easily digestible, highly nutritious product and is much used in the tropics. Stanley in his journeyings in Central Africa depended upon banana flour as his staple food. Mixed with wheat flour it may be made into very palatable cakes. Prepared in the form of gruel it affords a light and easily digestible form of nutriment for feeding certain classes of invalids, particularly when it is desired to combat intestinal toxemia.

Banana Figs.

When dried, the ripe banana becomes a sweet leathery product somewhat resembling a dried fig in consistency but less sweet and much less palatable. Various attempts have been made to popularize banana figs in this country thus far without success. In this highly favored part of the world so many attractive foodstuffs are available it is doubtful whether this very wholesome, if not highly attractive foodstuff, will ever come into general use.

The Fig.

This is one of the oldest cultivated fruits. It is generally eaten in the dried state, its content of sugar being sufficiently great to preserve it. The ripe fig eaten fresh from the tree is one of the most delicious of fruits. Eaten either fresh or dried, the fig is highly laxative on account of the large amount of cellulose which it contains, due to its tough skin and great number of small seeds.

The dried fig has a nutritive value double that of lean beef. This excellent fruit is too little appreciated and used in the United States. In many parts of the Orient, particularly in Smyrna and in southern Greece, the dried fig is one of the staple articles of food of the peasantry. Coarse bread, ripe olives, and dried figs furnish a complete meal for the Greek sailors who man the ships of the Mediterranean. The fresh, undried ripe fig is a most excellent fruit but quickly perishable. The purple fig of California is particularly valuable as a laxative, and if properly prepared and preserved without the addition of cane sugar, would be a most valuable addition to the national bill of fare.

The dried purple fig soaked for 48 hours in cold water and eaten freely twice a day is an excellent remedy for constipation.

The Date.

The date, like the fig, has come to us from prehistoric times. Until recently, its culture was wholly confined to the Orient. Its cultivation has in recent years been undertaken in the Coachella Valley and neighboring parts of the Colorado Desert in Southern

California. The date affords nearly three-fourths (70 per cent.) its weight of sugar, besides a considerable amount of protein, which sometimes rises as high as 7 per cent.

Recent studies of the sugar content of the date have shown that while cane sugar is always present in the immature date, it generally disappears to large extent in the process of ripening, so that the fully ripe date contains almost exclusively invert sugar; that is, the sugar usually found in fruits,—dextrose and levulose, in about equal parts. The Deglet Nur, grown in Algeria and California, is practically the only well known date which contains cane sugar. Professor Vinson, of the University of Arizona, found in the Deglet Nur 41.4 per cent. of cane sugar and a little more than 4 per cent. each of levulose and dextrose. The Fard and most other commercial dates grown or sold in the United States are of the invert sugar varieties. Most dates eaten contain not more than 10 per cent. of cane sugar, with a total sugar content of about 70 per cent.

It is gratifying to note that the date industry, especially in the Coachella Valley, is making rapid advancement, and it is to be hoped that in time this superior fruit may be produced in sufficient quantity to supply our home market. It is particularly important that the growth of invert sugar dates should be encouraged because of the superior value of the invert form of sugar, due to the fact that it is ready for immediate absorption and utilization, whereas cane sugar requires a somewhat prolonged digestive process to prepare it for absorption.

It is believed by many eminent authorities that the free use of cane sugar in this country may be one of the causes of the increasing prevalence of diabetes, and Sherman has called attention to the fact that the large use of cane sugar in the form of confectionery and otherwise results in extensive lime starvation, which affects probably half the population of the United States. To this may be attributed the dental caries which is becoming almost universal in this country even in children, as well as other forms of disease of the bony structures of the body. The substitution of dates and other sweet fruits for the present free use of cane sugar would unquestionably greatly improve the health of the American people. The sugar in the date is not only a natural sugar, which is ready for immediate absorption, but in its natural state the sugar of the date is associated with the lime, iron, vitamins and other essential food constituents which are altogether lacking in cane sugar. (See pages 170, 180).

The dates of commerce should be prepared for use by washing. This rule should, in fact, apply to all sorts of dried fruits, especially those imported from the Orient. The latter, in addition to washing, should be subjected to the disinfecting action of a 2 per cent solution of peroxide of hydrogen, in which the fruit should be soaked for four or five minutes after washing. After disinfecting, the dates should be dried if not used at once. American grown dates are clean and need no disinfecting.

The Guava.

This fruit, a native of the tropics, is now grown quite extensively in Florida and southern California. It has a rich, peculiar flavor which by many is greatly relished. The red, or strawberry, guava grown in Southern California is very palatable. The guava has a nutrient content of about 20 per cent., the greater part of which is sugar.

The Mango.

This highly palatable tropical fruit is now produced in considerable abundance in southern Florida. As this fruit becomes better known, it will be more and more appreciated as a valuable addition to our growing list of fruits.

The Pawpaw.

This wonderful product of the tropics, known in Mexico as the melon sapote, is one of the most remarkable of fruits. The pawpaw, when mature, is nearly as large as a muskmelon, and has a rich, sweet pulp of such consistency that it may be eaten with a spoon. It contains papayotin, a digestive principle resembling pepsin and pancreatin.

The Papaw.

The papaw, though similar in name to the pawpaw is very different. In flavor it somewhat resembles the banana and is much appreciated by those who have cultivated a liking for it. This fruit now growing wild in many parts of the United States should be cultivated and improved and may sometime become a very valuable orchard fruit. Its composition is, protein 5.2 per cent.; fat .9; carbohydrate (sugar) 6.8; ash .5; water 76.6.

The Pineapple.

This luscious fruit is grown in Central America, Porto Rico, the Sandwich Islands, the Philippines, the West Indies and in the southermost part of Florida. When ripened before picking, this is one of the most delicious of fruits, affording nearly 25 per cent of its weight of sugar and one-half of 1 per cent of citric acid.

As found fresh in the markets, the pineapple is usually somewhat inferior in quality, having been picked before fully ripe. Although the pineapple contains a ferment which has an action upon proteins resembling that of pepsin and pancreatin, it is rather indigestible unless cooked or eaten in its fully mature state.

The Pomegranate.

This ancient fruit, formerly little known in this country because of the difficulty of importing it, is now produced in considerable quantity in California and certain Southern states. Its leathery rind encloses a mass of highly delicious pulp, the juice of which contains more than 13 per cent of sugar and one-half of 1 per cent of citric acid.

The Avocado, or Alligator Pear.

This is a remarkable tropical fruit, a native of Mexico, now cultivated in Florida and Southern California. The tough green or reddish rind of this fruit encloses a thick yellow pulp which has the consistency of chilled butter and contains besides 2 per cent of protein and 6 per cent of sugar, fifteen or twenty per cent of highly digestible, emulsified fat, or as much as rich cream. This is indeed a very precious characteristic which will render it invaluable as a fat-building food when the supply becomes more regular and abundant. The U. S. Bureau of Plant Introduction promises to supply in the near future different varieties of the avocado which will yield fruit in every month of the year. The avocado is the ''meat'' of the Guatemalans who do the hardest work on a diet of tortillas (corn cakes) and avocados.

The avocado supplies not only a remarkably fine quality of fat, but a protein probably about equal to that of milk in its nourishing value.

Still another superior quality of this fruit is its richness in vitamins, one of the latest finds about it. When fed to rats, the avocado was found to promote growth in a most remarkable way.

It is evident that the avocado is a most valuable addition to our food supply. The tree which produces it grows rapidly and begins to bear early. It flourishes in Southern Florida in the vicinity of Miami, and in certain sheltered spots in Southern California. Lower California is an ideal place for the growth of this as well as other tropical plants. If ever Uncle Sam finds some way to add this strip of tropic sunshine to his dominions, it will become the market garden of the whole country.

The soft pulp of the avocado may be easily worked into an emulsion, which by the addition of water becomes a delicious and nourishing milk which ought to prove a good food for babies and invalids.

Mr. Popenoe and his sons have done much both individually and in connection with the Plant Introduction Bureau of the U. S. Department of Agriculture, under the direction of Dr. David Fairchild, toward making accessible to the people of this country some of the choicest products of the tropics, a contribution to the public welfare of far greater value than the discovery of a new gold field.

The avocado begins to bear three years from the seed, producing fruits which weigh from a pound to two and one-half pounds each. An acre of land planted to avocado trees will produce from 600 to 1,000 pounds of fat, much more than can be produced by any other crop known.

The Karob.

The karob is a fleshy pod having a sweet flavor somewhat resembling that of the date, produced by a tree resembling the locust. It is cultivated to some extent in Egypt and other tropical countries. The fruit is commonly known as St. John's bread.

The mesquite tree of the Colorado desert, Western Texas, Arizona, and Northern Mexico produces a somewhat similar fruit having a sweetish flavor. It has been much used by the Indians for food and is much relished by cattle and mules.

DRIED FRUITS

Dried fruits are highly valuable, though to some extent depreciated by the process of drying. It has been shown that the ordinary processes of drying fruits destroy in large part, and sometimes entirely, the rich store of vitamins present in fresh fruits. Ordinary dried fruits are of little or no value as antiscorbutics. In most other particulars dried fruits are nearly as valuable as fresh. When carefully dried by the most up-to-date methods, some fruits contain a considerable part of their vitamins, and when soaked in water recover almost their original freshness in appearance and flavor. The prune and the blue California fig are much more efficient as remedies for constipation, as well as more palatable, when prepared by simply soaking for 24 to 48 hours in cold water and without cooking. Fresh milk, with tomatoes, potatoes and other foods rich in vitamins, should be liberally used with dried fruits. Drying does not destroy the vitamins of the tomato.

The following table shows the composition of the dried fruits in ordinary use:

TABLE XXXIII.

Percentage Composition of Dried Fruits.

	Water	Protein	Carb.	Fat	Acids	Fibre	Salts	Cal. per ounce
Apples	28.1	1.6	57.6	2.2	3.6	4.9	2.0	85.2
Apricots	29.4	4.7	56.0	1.0	.3	7.5	2.4	81.2
Bananas	29.2	5.3	55.5			2.1	5.3	69.5
Banana flour	9.7	3.1	83.4			.7	2.6	
Currants, Zante	17.2	2.4	74.2	1.7			4.5	93.5
Dates	20.8	4.4	65.7	2.8		5.5	1.5	98.8
Figs	18.8	4.3	67.3	.3		7.3	2.4	90.0
Pears	16.5	2.8	66.0	5.4		6.9	2.4	92.4
Prunes	21.0	2.1	70.0		2.7	2.3	2.3	83.6
Raisins	14.6	2.6	73.6	3.3		2.5	3.4	92.0
Raspberries	8.1	6.5	50.0	1.8	6.0	25.0	2.6	69.1

Certain fruits, particularly figs and raisins, are generally dried in the sun. This method, however, exposes the fruit to contamination by dust and insects. The modern improved methods of artificial drying afford a much cleaner and more uniform product. The great fruit industry of California has stimulated invention to such an extent that at the present time the art of drying fruit has attained a very high degree of perfection, and has developed the enormous industry which produces annually more than half a billion pounds of dessicated fruits.

Dried fruit has the advantage that it retains most of the properties of the fresh fruit, occupies less bulk, and with proper precaution may be preserved for a considerable time.

A bushel of fresh apples weighing fifty-five pounds, in the process of drying loses more than forty pounds of water. The loss of water in the drying of some other fruits is even greater. The fruits for which the greatest demand in the dried state has existed heretofore, are the apple, peach, apricot, raisin, date and fig; but there is an increasing demand for the dried banana and banana flour, two excellent products which present a choice quality of nutritive material in easily digestible form.

CANNED FRUITS

The preservation of fruits by canning has greatly enriched our winter and spring bill of fare and provided a useful supply of appetizing carbohydrate foods at a season when, in former times, the dietary often became monotonous.

When canned in tin, the organic acids of fruits are likely to attack the container and may thus become contaminated with lead from the solder. After a long time, the acid may even attack the tin. This difficulty has been largely overcome in recent years by the application of enamel to the inside of the can. Glass fruit cans are evidently much better adapted to the preservation of fruits than tin containers.

It is to be remembered, also, that the antiscorbutic vitamin is likely to be greatly impaired, even destroyed, by the heat employed in processing canned fruit. Fortunately, the temperatures employed in the canning of fruits are not so high as those required for vegetables. and on this account the vitamins are less damaged. The juice of canned tomatoes has been found to be an excellent antiscorbutic.

Canned fruits, as well as other foods which contain preservatives, such as benzoate of soda, are unwholesome and should never be used. The following table shows the average composition of canned fruits in general use:

TABLE XXXIV.

Showing the Percentage Composition of Canned Fruits.

	Water	Protein	Fat	Carb.	Salts	Calories per oz.
Apples, Crab	42.4	.3	2.4	54.4	.5	70
Apricots	81.4	.9		17.3	.4	21
Apple Sauce	61.1	.2	.8	37.2	.5	44
Blackberries	40.0	.8	2.1	56.4	.7	72
Blueberries	85.6	.6	.6	12.8	.4	17
Cherries	21.0	1.1		77.2	.7	91
Peaches	88.1	.7	.1	10.8	.3	14
Pears	81.1	.3	.3	18.0	.3	22
Pineapples	61.8	.4	.7	36.4	.7	45
Prune Sauce	76.6	.5	.1	22.3	.5	27
Strawberries	74.8	.7		24.0	.5	29
Tomatoes	94	1.2	.2	4.0	.6	

FRUIT JUICES

The value of fruit juices is as yet quite too little appreciated. Fruits differ from practically all other foods in the fact that their nutritive elements exist in the soluble forms of sugar, dextrin and acids, and hence are almost exclusively found in their juices. The dry pulp left after the expression of the juice, contains almost nothing except cellulose, a little protein and the major part of the salts.

Fruit juices of all sorts are exceedingly wholesome. They contain all the valuable properties of the fruits from which they are prepared with the exception of cellulose. The popular prejudice against acid fruit juices on the ground that they encourage the development of rheumatism is entirely without scientific basis. Fruit juices, like fruits, are rich in the salts of sodium and potassium and increase the alkalinity of the blood and tissue fluids.

The aromatic oils of fruit juices which give to them their characteristic flavors are appetizing and thus promote digestion. It is probable that many persons who are in the habit of using light wines value them for their fruity flavors rather than for any effects experienced from the alcohol present. The general introduction of grape juice and of other fruit juices in recent times has no doubt contributed in no small degree to the success of the prohibition movement. An effort should be made to replace the wine and beer of ante-prohibition days by fruit juices of many different sorts.

By means of a recent invention it is now possible to retain in fruit juices, in concentrated form, the aroma which was formerly lost in the processes of canning and condensation.

Fruits and fruit juices are for the most part eaten as luxuries rather than as food staples. As a matter of fact, fruits and the juices of fruits are worthy of a more dignified position on the bill of fare. A half pint of grape juice has a food value of 200 calories, fully equal to that of a like quantity of milk, though of a different sort, consisting of sugars with practically no protein or fat.

Fruit juices, even much diluted, as in the form of lemonade, orangeade and similar drinks, contain an amount of nourishment worth considering. For example, as ordinarily made, a glass of lemonade (six ounces) affords 85.2 calories. In this case, the greater part of the calory value is due to the sugar employed for sweetening. Cane sugar may be taken in this diluted form with less injury than in any other way.

The establishment of prohibition has made of grape juice a national beverage. Other juices are equally valuable. Loganberry juice is rapidly gaining in favor and orange juice now appears on the bill of fare of every first-class hotel or restaurant. The amount of food material found in fruit juices is much larger than is generally supposed. This will readily appear by reference to the accompanying table, in which it will be seen that the juices of the blackberry, grape, pear, the raspberry and the strawberry, and even the pineapple, all equal or exceed whole milk in nutritive value; in fact, with the exception of lemon and orange juice, fruit juices, in general, are practically equal to milk in the actual amount of nutriment which they supply. Of course, none of these juices could take the place of milk as a food for the reason that the nutriment which they furnish is almost exclusively carbohydrate. There are conditions, however, in which exclusive carbohydrate feeding is desirable, as in certain cases of acidosis. In such cases fruit juices become a valuable resource.

Fruits usually contain the anti-scorbutic vitamin but are, however, rather poor in other vitamins. This important fact to which attention has been called, emphasizes the necessity for accurate information in the making of bills of fare for the sick, since it may frequently happen that the patient is already suffering from a deficiency of some one or all of the three vitamins known to be essential to good nutrition. For example, a person attempting to live on a diet of fruits and nuts would suffer from lack of the water-soluble, or antiscorbutic vitamin, if the bill of fare was largely made up of dried fruits such as figs, dates and raisins, with nuts, even though the supply of carbohydrates, fats and protein might be very ample.

On this account it is well always to include with the fruit and nut diet a liberal allowance of oranges to supply water-soluble vitamins B and C, and greens, carrots, butter or tomato, to supply the needed fat-soluble A.

The tomato, either fresh or dried, is always a most safe addition to the bill of fare because it is rich in all the vitamins. Dried tomato contains twice as much of the fat-soluble vitamin as does the same weight of butter.

TABLE XXXV.

Composition of Fruit Juices

	Calories per Ounce			
	Protein	Fat	Carbo-hydrates	Total
Apple Juice	0	0	17	17
Blackberry Juice	0	0	30.3	30.3
Blueberry Juice	0	0	18.9	18.9
Grape Juice	0	0	23.8	23.8
Orange Juice	0	0	15.1	15.1
Peach Juice	0	0	20.8	20.8
Pear Juice	0	0	25.6	25.6
Pineapple Juice	0	0	21.8	21.8
Raspberry (red) Juice	0	0	23.7	23.7
Raspberry (black) Juice	0	0	29.4	29.4
Strawberry Juice	0	0	24.5	24.5
Lemon Juice	0	0	11.4	11.4

It should be noted that the figures of the above table represent fruit juices as they are usually served and include a small addition of cane sugar to the natural juice. This is true in practically all instances except orange juice and lemon juice.

TABLE XXXVI.

Showing the Composition of Commercial Lime Juices.

The following analyses were made by the Canada Inland Revenue Department:

	Solids	Citric acid	Preservative
Blackwood's	8.8	7.6	Salicylic acid
Dalton's	7.2	7.1	
Dominica	10.6	8.1	Benzoic acid
Eaton's	8.7	6.9	Salicylic acid
Howard's	6.7	6.6	
Montserrat	9.2	8.0	
Olympia	7.8	7.3	Benzoic acid, none
Rose's	8.6	7.9	Benzoic acid, none, or sulphurous acid
Royal	--	6.9	
Sovereign	8.0	7.2	Salicylic acid, benzoic acid, none, or sulphurous acid
Sterling	7.3	6.8	Benzoic acid, salicylic acid, or none
Victoria Cross	9.3	7.7	Sulphurous acid
White Star	7.9	6.9	

Nuts

The nut is one of the oldest and best of Nature's products intended as food for man. The paleontologists tell us that early man was a nut eater as are the gorilla, the orang-utan, and the chimpanzee, his modern prototypes. The chestnut has been from the most ancient times a staple article of food in Northern Italy. The early inhabitants of Great Britain were acorn eaters, as were the ancient Greeks.

In modern times nuts have been used as a luxury rather than as a staple article of food; but as the public become better informed respecting the high food value of nuts and especially in view of the steadily rising cost of flesh meats, the nut is certain to gain higher appreciation, and the writer has no doubt that some time in the future nuts will become a leading constituent of the national bill of fare and will displace certain foodstuffs which today are held in high esteem but which in the broader light of the next century will be regarded as objectionable and inferior foods and will give place to the products of the various varieties of nut trees which will be recognized as the choicest of all foods.

Botanically, a nut is a fruit; but nuts differ so widely both in composition and appearance from the foods commonly called fruits that they are properly classed by themselves.

In nutritive value the nut far exceeds all other food substances; for example, the average number of food units per pound furnished by half a dozen of the more common varieties of nuts is 3231 calories while the average of the same number of varieties of cereals is 1654 calories, half the value of nuts. The average food value of the best vegetables is 300 calories per pound and of the best fresh fruits grown in this country, 278 calories. The average value of the six principal flesh foods is 810 calories per pound or one-fourth that of nuts.

The superior nutritive value of nuts is clearly shown by the following table:

TABLE XXXVII.

Composition and Fuel Value of Edible Portion of Nuts.

	Protein Per Ct.	Fats Per Ct.	Carbohydrates Per Ct.	Ash Per Ct.	Food Value Per Pound Calories
Almonds	21.0	54.9	17.3	2.0	3,030
Brazil nuts	17.0	66.8	7.0	3.9	3,329
Filberts	15.6	65.3	13.0	2.4	3,432
Hickory nuts	15.4	67.4	11.4	2.1	3,495
Pecan nuts	11.0	71.2	13.3	1.5	3,633
English walnuts	16.7	64.4	14.8	1.3	3,305
Chestnuts, fresh	6.2	5.4	42.1	1.3	1,125
Chestnuts, dried	10.7	7.0	74.2	2.2	1,875
Acorns	8.1	37.4	48.0	2.4	2,718
Beechnuts	21.9	57.4	13.2	3.5	3,263
Butternuts	27.9	61.2	3.4	3.0	3,371
Black walnuts	27.6	56.3	11.7	1.9	3,105
Cocoanuts	5.7	50.6	27.9	1.7	2,986
Cocoanuts, shredded	6.3	57.3	31.6	1.3	3,125
Pistachios, kernels	22.6	54.5	15.6	3.1	3,010
Pine nuts or piñons	14.6	61.9	17.3	2.8	3,364
Peanuts, raw	25.8	38.6	24.4	2.0	2,560
Peanuts, roasted	30.5	49.2	16.2	2.5	3,177
Litchi nuts	2.9	.2	77.5	1.5	1,469

Recent studies of the proteins of nuts by Osborne and Harris, Van Slyke, Johns and Cajori, have demonstrated that the proteins of nuts are at least equal to those of meat. This has been shown to be true of the almond, English walnut, black walnut, butternut, peanut, pecan, filbert, Brazil nut, pine nut, chestnut, hickory and cocoanut; that is, of practically all the nuts in common use.

Observations seem to show that, in general, the proteins of oily seeds are complete proteins.

Cajori's research has also shown the presence of growth-promoting vitamins in abundant quantity in the almond, English walnut, filbert, pinenut, hickory, chestnut and pecan.

That the nut is appreciated as a dainty is attested by the frequency with which it appears as a dessert and the extensive use of various nuts as confections. That nuts do not hold a more prominent place in the national bill of fare as food staples is due chiefly to two causes; first, the popular idea that nuts are highly indigestible, and second, the limited supply.

The notion that nuts are difficult of digestion has really no foundation in fact. The idea is probably the natural outgrowth of the custom of eating nuts at the close of a meal when an abundance, more likely a super-abundance, of highly nutritious foods has already been eaten and the equally injurious custom of eating nuts between meals.

Neglect of thorough mastication must also be mentioned as a common cause of indigestion following the use of nuts. Nuts are generally eaten dry and have a firm hard flesh which requires thorough use of the organs of mastication to prepare them for the action of the several digestive juices. It has been experimentally shown that nuts are not well digested unless reduced to a smooth paste in the mouth. Particles of nuts the size of small seeds may escape digestion. Nut paste or "butter" is easily digestible.

Delicious nut butters may be prepared from true nuts such as the almond, filbert, and pine-nut, by blanching and crushing, without roasting. Peanuts require steam roasting. Over roasting renders the nut difficult of digestion.

According to the New Zealand Dairyman, more than 50,000 tons of nut butters are produced in England every year. Peanut oil, palm kernel oil and coconut oil are the principal raw materials used. In face of vanishing meat supplies it is most comforting to know that meat of all sorts may be safely replaced by nuts not only without loss, but with a decided gain. Nuts have several advantages over flesh foods which are well worth considering.

1. Nuts are free from waste products, uric acid, urea, and other tissue wastes which abound in meats.

2. Nuts are aseptic, free from putrefactive bacteria, and do not readily undergo decay either in the body or outside of it. Meats, on the other hand as found in the markets, are practically always in an advanced stage of putrefaction. Ordinary fresh dried or salted meats contain from three million to ten times that number of bacteria per ounce, and such meats as Hamburger steak often contain more than a billion putrefactive organisms to the ounce. Nuts are clean and sterile.

3. Nuts are free from trichinæ, tapeworm, and other parasites, as well as other infections due to specific organisms. Nuts are in good health when gathered and usually remain so until eaten.

In view of these facts it is most interesting to know that in nuts, the most neglected of all well known food products, we find the assurance of an ample and complete food supply for all future time, even though necessity should compel the total abandonment of our present forms of animal industry.

Another of the great advantages of the nut is that with few exceptions, it may be eaten direct from the hand of nature without culinary preparation of any sort. Indeed, the common custom of offering nuts as dessert is an acknowledgment that in the nut the refined chemistry of Nature's laboratory permits of no improvement by the clumsy methods of the kitchen.

The superior food value of nuts will appear from the fact that:

One Pound of Walnut Meats Equals in Food Value

	Pounds
Beef loin, lean	4.00
Beef ribs, lean	6.50
Beef neck, lean	9.50
Veal	5.50
Mutton leg, lean	4.20
Ham, lean	3.00
Fowls	4.00
Chicken, broilers	10.00
Red Bass	25.00
Trout	4.80
Frogs' legs	15.00
Oysters	13.50
Lobsters	22.00
Eggs	5.00
Milk	9.50
Evaporated cream	4.00

Every highway should be lined with nut trees. Many nut trees will grow on land unsuited to ordinary farm crops. The pinon flourishes on the bleak and barren peaks of the rockies.

A few nut trees planted for each inhabitant would insure the country against any possibility of food shortage. A row of nut trees on each side of our 3,000,000 miles of country roads would provide protein for a population of 100,000,000.

Nuts should be eaten at every meal and made a substantial part of the bill of fare. So long as the nut is regarded as a dainty, suitable only for dessert, the demand will be limited. But as its merits come to be appreciated it will be in greater demand and the supply will rapidly grow in volume.

The Lime Content of Nuts.

In proportion to their weight, nuts contain more lime than any other class of foodstuffs except legumes, the average being more than one-third grain to the ounce (.370 grs.). Certain nuts are surprisingly rich in lime. For example, the almond offers nearly one and a half grains of food lime to the ounce, while the hazelnut or filbert affords one and three-quarters grains of lime to the ounce, or 11.3 per cent of a day's ration of lime. The pecan and the walnut are also fairly rich in lime, as is also the peanut.

An ounce and a half each of almonds and hazelnuts or filberts will supply one-third the total lime requirement for a day. In general, this addition to the ordinary bill of fare would be quite sufficient to insure against any serious deficiency of lime.

By a combination of the proper nuts and fruits, the most delicious of all food combinations, the total needed supply of lime, or at least the major part of it, may be readily secured.

Here is a convenient example which may well serve as a model supplementary lime ration for general use. Take at one meal a large orange and an ounce and a half of almonds. At another meal, an ounce and a half of filberts and two ounces of figs. These nuts and fruits would supply fifty per cent of the necessary lime, and by adding for a third meal two oranges and two ounces of walnuts more than three-fifths of the total lime requirement would be furnished.

Evidently there is no need of lime starvation if one only knows how to make a right selection of foods.

The Iron Content of Nuts.

The almond, hazelnut, chestnut, peanut, pecan and walnut, all contain a rich store of iron, the average iron content expressed as per cent. of the iron ration being 4.79, more than two and one-half times that of fruits (1.74), three times that of vegetables (1.46), greater than that of cereals and even superior to average meats. It is true that the extraordinarily high food value of nuts renders them less available than fruits as prime sources of iron, for one would have to eat 5,000 calories of chestnuts or walnuts or more than 4,000 calories of pecans or peanuts to get a day's ration of iron; but three-quarters of a pound of almonds or hazelnuts would supply the needed quantum of iron with an energy intake of 2,500 calories, on account of their unusually rich store of iron.

It is worth while to know that vegetable milk prepared from almonds, by adding five parts of water to one part of blanched almonds made into a smooth paste, supplies two and a half times as much iron as does cow's milk in equal quantity, and furnishing the same amount of protein. It is worth noting just here, also, that the protein of the almond is, like that of milk, a complete protein, that is, a protein out of which human tissues may be readily formed, which is by no means true of all vegetable proteins. Such a milk, however, would be somewhat deficient in lime, a lack which could be supplied by lentil soup.

A product commercially known as Malted Nuts, prepared from almonds or peanuts, has been found of very great service in meeting the needs of infants and some classes of invalids for an easily digestible liquid nourishment to take the place of milk when a substitute is needed.

Of the nuts which grow in this country, the most important are the almond, the English walnut, the pecan and the peanut. The native black walnut, the hickory nut, the pinon, the hazelnut, and the beechnut are all valuable nuts which, by cultivation, might furnish enormous additions to our food supply. This is particularly true of the black walnut.

Among the imported nuts, the most important are the Brazil nut, the coconut, the pistachio, and the recently introduced litchi nut.

A study of the relative protein content of nuts, milk, and meat shows that, pound for pound, the almond, beechnut, and walnut contain on an average as much protein as does meat and five times as much as is found in milk, and protein which from rat feeding experiments appears to be of equal value. The chestnut, the chinquapin, the filbert, the hickory, pecan and pine nut contain on an average as much protein as is found in fish, while the butternut, the peanut and pignolia contain twice as much or 50 per cent more than is found in the best cuts of meat.

The following table shows the number of pints of milk equaled by one pound each of the several nuts mentioned, together with the calory value of the nuts per pound and of the amount of milk containing an equivalent amount of protein and the amount of each kind of nuts needed to supply supplementary protein for one day:

TABLE XXXVIII.

	Milk		Nuts	
	Pints	Calories	Calories	Ounces
Acorn	2.4	780	2620	8.3
Almond	6.4	2080	3030	3.2
Beechnut	6.6	2145	3075	3.0
Butternut	8.5	2762	3165	2.4
Chestnut	3.2	1040	1876	6.4
Chinquapin	3.3	1072	1800	6.4
Filbert or Hazelnut	5.0	1625	3290	4.0
Hickory nut	4.6	1495	3345	4.8
Pecan	3.6	1170	3455	5.6
Peanut	9.2	2090	2600	2.2
Piñon	4.4	1430	3205	4.8
English walnut	5.4	1555	3300	3.7
Black walnut	8.5	2762	3105	2.4

The Vitamins of Nuts.

Coward and Drummond have shown (Biochemical Journal, 1920), that the fat-soluble A is present only in very small percentage in nuts (Brazil, Barcelona, peanut, walnut, almond, butternut). In general the fat-soluble A vitamin is very sparingly found in seeds and is abundant only in the green parts of the leafing plant, in green shoots and in dairy products.

The Almond.

The almond perhaps deserves to be placed at the head of the list of all edible nuts. It is one of the finest of all the products of the vegetable kingdom. Until recently the almond was produced almost exclusively in Oriental countries bordering on the Mediterranean. In recent years the culture of the almond has been greatly developed in California and to some extent in Florida. The so-called Jordan almond is the largest and best flavored of all the numerous varieties of the almond. The name Jordan does not refer to the Jordan river but is a corruption of an original word meaning garden, which was applied to this variety of nut for the reason that it was first raised only in gardens. The almond contains a protein very similar to that found in milk, which is soluble in warm water. It also contains an emulsifying principle. Because of these characteristics a very delicious milk may be prepared from the almond, the composition of which is not very greatly different from that of ordinary cow's milk. The almond contains no starch but some sugar. About

50 per cent of the nut consists of a fine quality of oil which is easily digestible.

The almond has the advantage over many other nuts in the fact that the astringent, leathery skin with which it is covered, may be easily removed by a simple process of blanching.

An ounce of almonds blanched and slightly roasted, or crushed and served as a nut butter, is a most wholesome addition to any meal and may be used once or twice a day with advantage.

Almond Milk.

Shelled almonds are blanched by dipping the nuts for a moment in boiling water. Care should be taken not to allow the nuts to soak in the water. The skins of the soaked nuts will soon swell, when they may be rubbed off. The nuts are then dried and afterwards ground through a nut butter mill. By the addition of water with a little salt, and if desired, sugar, a very palatable cream or milk may be made. The water should be added gradually with vigorous stirring. At first the nut paste will swell up and thicken into a semi-translucent mass. As more water is added, with thorough mixing, the mass gradually assumes the appearance of thick cream. By the further addition of water, cream or milk of the desired consistency may be produced.

Almond milk is a fairly good substitute for cow's milk. It is said to have been used successfully in the feeding of babies in cases in which cow's milk disagreed. Almond milk is a delicacy which may be used by invalids who dislike cow's milk or who are sensitized to it.

Almond milk or cream may be most conveniently prepared from almond butter, which is made by certain manufacturers of food specialties.

The Hickory Nut.

The meat of the shellbark hickory nut is a most delicious morsel. It is richer in fat than any other nut with the exception of the pecan, a variety of the hickory which contains two-thirds its weight of easily digestible oil, with 15 per cent protein and 11 per cent carbohydrate. A pound of hickory nut meats is equal in nutritive value to more than 4 pounds of average meat.

The Indians made "hickory milk" by pounding the nuts, casting the mass into boiling water and passing through a fine strainer. The nut cream thus made was used in preparing hominy and corn cakes. Black walnuts were treated in the same way.

The new method of grafting improved varieties of hickory nuts upon hardy wild or seedling stock promises to greatly increase the production of this choice nut, the demand for which far exceeds the supply.

The Pecan.

The pecan, a near relative of the hickory nut, native to our Southern states, contains 4 per cent more fat and 4 per cent less protein than the hickory nut. In food value, a pound of pecan meats exceeds the hickory nut by 200 calories, and is perhaps the most highly nutritious of all the natural products of the vegetable kingdom. In fact, with the exception of pure fat or oil, there is no food substance which offers nutritive material in so concentrated a form.

The Walnut.

The native black walnut is perhaps the finest food producing tree indigenous to this country. The fat of walnut meats equals nearly three-fifths its weight, and the protein content is nearly 28 per cent, giving a nutritive value three times that of fat meat. A pound of walnuts, in fact, contains nearly 50 per cent more protein than the same quantity of beef, besides two-thirds as much fat as a pound of butter.

This fine nut is deserving of more consideration than it has thus far received. No investment could be more certain of a good return than the planting of a walnut orchard in suitable soil. It is a hardy tree and its wood is sufficiently valuable to pay the full cost of production.

The walnut is also a fine shade tree. It might well replace many of our shade and ornamental trees in city streets and parks which produce nothing but leaves.

The English Walnut.

This excellent nut is now grown in great quantities in California, and some hardy strains are being grown in the Eastern states. It is less highly flavored than the black walnut and has less than two-thirds as much protein.

The Butternut.

This relative of the black walnut produces a very rich nut containing barely three per cent of carbohydrate, less than any other nut, which renders it a valuable food for diabetics.

The Pine Nut.

There are numerous varieties of pine nuts. The most common in this country is the pinon, which grows wild and produces great quantities of small but delicious nuts on the rocky slopes of the coast range in California, where it still forms an important element in the diet of certain tribes of Indians. Nut pines of various sorts grow in South America, Spain, and on the West Coast of Africa, where there are great forests of nut pines which produce an annual crop large enough to supply fat and protein to whole provinces. Some varieties of the pine nut produce seeds as large as chestnuts and somewhat resembling the kernel of the chestnut in appearance and in chemical composition.

As found in the market, shelled pine nuts are dirty and quite unattractive in appearance; but the nut meats may be easily cleansed by washing first with ordinary water then with water containing half of one per cent of peroxide of hydrogen. This will not only cleanse but disinfect the nuts, destroying germs of any sort with which the kernels may have become infected in their peregrinations from the distant forest to the dinner table. The nut meats may be quickly dried by exposure to the heat of an oven. The flavor of the nuts is improved by very slight roasting.

The Chestnut.

The cultivated chestnut is produced in enormous quantities in some parts of Europe. A wild variety of chestnut grows in some parts of the United States, but is rapidly disappearing under the influence of a recently developed blight.

In composition the chestnut is much like the acorn, containing little fat, a moderate amount of protein and a large amount of starch. It is usually eaten after boiling or steaming and roasting. A kind of cake which is used as bread, and various other dishes are prepared from chestnut meal in Italy, where a large and highly valuable variety of the chestnut is very widely grown and constitutes quite a proportion of the sustenance of the people of the Northern provinces.

The Chinquapin.

This nut is a sort of dwarf chestnut, being about half the size of the latter. It is, however, sweeter in flavor, and the tree on which it grows is more hardy than the chestnut.

Filberts, Cob Nuts, and Hazelnuts.

These closely related nuts are rich in fat and protein of very fine flavor and rank close to the almond in food value. Filberts are grown in most European countries and especially in Spain. The cob nut grows in Ireland and the hazelnut is a common wild bush in many parts of this country. A fine nut-butter may be made from blanched filberts.

The Beechnut.

A delicious nut, the product of the beech tree. It is characterized by its exceeding richness in oil, of which it contains about 60 per cent. Although the beechnut has a very delicious flavor and is a very choice nut it is comparatively little eaten by human beings because its small size renders it difficult to collect and prepare for food. The nut grows abundantly in certain countries, particularly in Silesia, where the oil is used as a substitute for butter.

The Acorn.

The acorn is a farinaceous nut, the product of the oak tree. In ancient times it was very extensively used for food in the British Islands and in other parts of Europe. The acorn is still extensively used as a food in certain parts of Turkey. More than 300,000 Indians living in California when first visited by white men had thrived for hundreds of years on a diet of which the acorn was the staple.

The nuts are prepared for use by first burying them in the ground for a certain time during which changes take place which destroy the tannic acid which gives to most varieties of the acorn an unpleasant bitter flavor. Another method of preparation is to grind the nuts into a coarse meal, then spread on sand and leach for several hours by pouring water on and allowing it to soak away.

There is reason to believe that the acorn was at one time the chief source of carbohydrate for primitive man in some of his forest abodes.

Composition of the Acorn.

	Leached	Unleached
Water	11.34	8.7
Protein	4.48	5.7
Fat	19.81	18.6
Carbohydrate	62.02	65.0
Fiber	2.06	6.6
Ash	.29	2.0

The acorn contains besides starch, tannic acid and oil a peculiar sugar, *quercin*.

The Ground Nut.

A native of this country which was eaten to considerable extent by the North American Indians in aboriginal times. It is nutritious and wholesome but not at present produced in quantities sufficient to give it more than a very minor place in the world's bill of fare.

The Brazil Nut.

This is a large So. American nut with a rich white meat containing more than 60 per cent. of fat, 17 per cent. of protein, with scarcely more than a trace of sugar, making it an excellent food for diabetics.

The Paradise Nut.

Somewhat resembles the Brazil nut, though finer in quality. Little used in this country.

The Coconut.

This highly valuable nut is the fruit of the coconut palm tree which grows in many tropical countries, especially India, West Indies, China, Japan, and the South Sea Islands. Within recent years the coconut tree has been grown to some extent in Florida. In tropical countries the cocoanut is chiefly eaten when in a green state. The nut is cut open, the water which it contains is used as a beverage, and the meat of the nut, which is at this stage of its development soft and creamy, is eaten with a spoon. In the ripe state the nut is rather indigestible unless very thoroughly chewed. It is very rich in wholesome fats and oils which may be prepared in the form of cream and butter, and form very acceptable substitutes for dairy products, although lacking in the valuable vitamins which are supplied by butter from cow's milk and are much preferable to lard.

Nut margarine and other coconut fats are prepared from the dried coconut meats. They are not a complete substitute for dairy butter, but are more easily digestible and more wholesome than lard and other animal fats and may be used safely if care is taken to include in the daily dietary liberal amounts of cottage cheese, skimmed milk or greens to supply the necessary vitamins which are deficient in most fats whether of animal or vegetable origin with the exception of butter.

Coconut Butter.

A very good butter may be prepared from the coconut by grinding the white meat fine as possible, soaking for an hour in hot water, then straining through cloth to separate the pulp and collecting the cream which rises as the milky liquid cools while standing for an hour or two. The thick cream which rises to the top is worked like butter, which it resembles in consistency.

The protein of the coconut has been shown by various experiments to be a complete protein and hence capable of taking the place of meat and milk proteins.

Jansen, of the Public Health Service of the Netherlands Indies, showed by experiments upon men and rats that growth and physical vigor may be maintained by a diet of rice and the coconut press cake remaining after the oil has been removed. In this country, coconut press cake has been used successfully for feeding cattle, and Cajori has shown its protein to be equal to that of meat.

The Cashew Nut.

A native of the West Indies, also grown extensively in certain parts of India. The seed of this curious nut is enclosed in a shell which contains a poisonous and highly irritating volatile oil. This is driven off by roasting the nuts. Thus prepared the nut has a highly delicious flavor and is easily digestible and wholesome.

The Peanut.

Though usually classed with nuts, the peanut is really a legume and botanically should be classed with beans and peas. In chemical composition, however, it much more closely resembles a nut than a bean. The peanut is a native of Central America. It is now grown, however, in all parts of the world. It is used extensively as a food in various parts of Africa, where it is known as the monkey nut.

Peanut oil has been extensively used as a substitute for butter and in the adulteration of olive oil. It must be remembered, however, that these vegetable oils do not contain the fat-soluble vitamins which abound in butter and which are essential for good nutrition.

Evidence is constantly accumulating to show the great food value of the humble peanut. Dietary studies made by the office of home economics of the U. S. Department of Agriculture have shown that the peanut is not only easily digested but that the fat and protein, which are its chief constituents, are of a very superior character. The oil of the peanut is easily digested and the protein has been shown to have about twice the value of the proteins of wheat. It is well known that experimental animals can not be brought to normal development on a diet of bread alone, but bread consisting of three parts of wheat flour and one of peanut flour will secure normal growth.

A bushel of peanuts contains 21 pounds of meats and 9 pounds of shells. As an average of 34 bushels can be produced to the acre, an acre will yield 714 pounds of shelled peanuts to the acre. One bushel of peanuts yields a gallon of fine edible oil which may take the place of olive oil for table use. A field of peanuts 200 miles square (25,000,000 acres) would furnish a year's supply of food fat for the United States.

Peanut Butter.

Many years ago (1893) it occurred to me that one of the objections to the extensive dietetic use of nuts might be overcome by mechanical preparation of the nut before serving so as to reduce it to a smooth paste and thus insure the preparation for digestion which the average eater is prone to neglect. The result was a product which I called peanut butter. I was much surprised at the readiness with which the product sprang into public favor. Several years ago I was informed by a wholesale grocer of Chicago that the firm's sales of peanut butter amounted on an average to a carload a week. I think it is safe to estimate that no less than one thousand carloads of this product are annually consumed in this country.

The ordinary method of preparing peanut butter renders the product more or less indigestible by setting free and decomposing some of the oil which constitutes nearly 50 per cent of the peanut. The ordinary commercial peanut butters are abjectionable on this account.

Peanut butter may be prepared at home by the following method: Obtain the desired quantity of shelled nuts. Dry in an oven not hot enough to roast, to loosen the skins. Place in a gunny sack and remove the skins by rubbing on the outside of the sack. Pick over carefully and exclude all skins and defective nuts. Place in thin layers on flat pans in an oven containing also a basin of hot water. The nuts should remain in the oven until slightly browned. Great care should be taken to avoid scorching, which produces poisons, "phenolic substances" (Sayre) which are highly objectionable. After the nuts are cooked they may be ground to a smooth paste in one of the numerous patterns of nut mills now easily obtainable.

Flour from the Peanut.

It has been found that by special treatment of the press-cake obtained after the extraction of the oil from the peanut an excellent flour, containing only five per cent oil, may be made. The flour contains a high percentage of an excellent protein.

Peanut Milk.

The protein of the peanut is quite soluble in hot water, and the fat being in a finely divided state, it is easy to prepare from peanut butter a very palatable cream or milk by the simple addition of hot water.

Malted Nuts.

Nearly thirty years ago (1892-3) the writer, in seeking to supply the needs of invalids unable to eat cow's milk, conceived the idea of combining malt digested cereals with nuts to prepare a substitute. The result finally reached after many experimental efforts was the product known as "Malted Nuts," which much resembles malted milk in appearance, while having a delicate and very agreeable nutty flavor. This product has been produced in considerable quantities and has come to be somewhat widely used. The following is the analysis made by Atwater, as published by the U. S. Department of Agriculture: Water, 2.6 per cent; protein, 23.7; fat, 27.6; carbohydrate (malt sugar and dextrin), 43.9; ash, 2.2. Calories per ounce, 140.

It was soon discovered that "Malted Nuts" had certain characteristic properties which rendered it of special value as a nutrient. One of these is its richness in food iron of which it contains double the amount found in ordinary beefsteak.

Another of the characteristic qualities of "Malted Nuts" is its influence upon the milk secretion in nursing mothers. This discovery was first made by a mother who by its use was able to double her milk production and to nurse the child of a neighbor in addition to her own. Later, Dr. Hoobler of Detroit, superintendent of a lying-in hospital, independently undertook an extended series of experiments, the interesting results of which, largely attained by the use of Malted Nuts, were reported in the Journal of the American Medical Association for August 17,

1917. The purpose of the research was to determine the influence of diet upon the milk production of nursing mothers. It has long been known that a simple increase of food or of fat has no other effect than to make the mother fat without increasing the flow of milk. Dr. Hoobler's experiments had for their purpose to determine the influence of individual foods and specially arranged dietaries upon the production of milk. Studies were made of the effects of meat, eggs, cow's milk, a strictly vegetable dietary (fruits, grains and vegetables), and nuts.

The influence of the diet was judged by the following points:

1. The amount of milk produced.
2. The food value of the milk.
3. The effect upon the mother in loss or gain of weight.

It was found that a diet consisting largely of nuts (fifty per cent), was far superior to any other dietary and in every particular. The amount of milk was larger than the average (14.8%), the food value was greater (30%), and the mother did better. It was noted that the mothers "took the diet readily and in fact enjoyed it."

"Malted Nuts" has been demonstrated practically the best substitute for milk which has thus far been found. It is relished by bottle-fed infants and "agrees" when cow's milk is not tolerated. It is also of value in cases of adults who cannot take milk without suffering from headache, hives, or other evidences of sensitization. When used as an exclusive food for a bottle-fed infant, an ounce of orange or tomato juice should be given the infant daily. It is also well to add daily a few ounces of lentil or potato soup.

Nut Meats—Protose.

Nut meat of excellent flavor and superior to meat in wholesomeness, may be prepared as follows:

To a suitable quantity of wet gluten (made by washing the starch out of wheat flour), add peanut meal with a little salt in sufficient quantity to produce a mass having the consistency of a thick mash. Bake in a thick layer in a dripping pan till slightly brown. Serve either with or without brown gravy. This preparation is an excellent entree and fully supplies the place of a meat dish.

Many years ago (1899) by request of the Assistant Secretary of the U. S. Department of Agriculture, experiments were undertaken by the writer to find a vegetable substitute for meat. The result was the production of Protose, a nut preparation, which to a considerable degree, resembles meat in appearance, taste and odor, having a slight fibre like potted meat. Some hundreds of tons of this and kindred nut foods have been made and used and have proved to be more than complete nutritive substitutes for meat.

Protose is a vegetable meat which has much the appearance, flavor, composition, and even the fiber of potted meat. This product has the further advantage of being wholly free from parasites, bacteria and bacterial products. It does not readily become putrid as meat, either in or out of the intestines. Protose contains more food iron than does beef and seven times as much lime. It is also rich in vitamins, in which meat is deficient, and is more easily digestible.

The superiority of vegetable meat (Protose) to ordinary flesh meats is clearly shown by the following table:

	Protose	Veal	Mutton (leg)	Ordinary steak	Chicken	Fish (bass)	Oyster	Egg
Protein	23	17.8	18.7	22.0	14.5	10.6	6.8	15.2
Fat	16	15.8	26.3	8.4	3.6	2.0	3.4	27.0
Carbohydrates	10	...	...	...	...	...	..	...
Total per lb.	784	538	686	486	290	202	163	675
Iron gr. per lb.	.3984	.1566	.1645	.1936	.1270	.464	.299	.3904
Lime gr. per lb.	6.6	.5	.6	.7	1.0	2.0	1.4	7.2

Another nut meat prepared from peanuts is known as *Nuttolene.*

The Litchi or Chinese Hazelnut.

This nut differs from all other nuts in the fact that it consists almost exclusively of a single food principle, sugar or carbohydrate. And the sugar is of the finest sort, that found in honey, rather than cane sugar. This nut also contains a small amount of citric acid, sufficient to give character to its flavor, which is very delicate and pleasing.

The litchi contains only a trace of fat, and minute amount of protein.

With the exception of the chestnut, the acorn, and certain pine nuts, nearly all nuts are rich in protein and fat, often containing half their weight or even more of fat. But here is a nut which is pure carbohydrate, and of a sort which requires no work of the digestive organs, being already digested by the ferments of the plant, and ready to be absorbed and utilized at once. It is claimed that the litchi nut will easily produce half a ton of sugar to the acre, and with almost no care, and no cost for manufacture. 8,000,000 acres planted to litchi nuts would thus furnish the 4,000,000 tons of sugar which the American people annually consume, and better sugar than the cane sugar of commerce, and at far less cost. We are only just beginning to appreciate the value of nuts as nutrients.

A little computation will show how easily the national food problem may be solved by utilizing the nut. Allowing an average of one ounce of protein, two ounces of fat, and twenty ounces of carbohydrate per capita, daily, for each one of the inhabitants of the United States, the aggregate would be produced by two good sized farms both of which could be easily comprized within one of our big states, one farm 300 miles square devoted to walnuts or hickory nuts to produce the million and a quarter tons of protein and two and a half million tons of fat required, and another of equal size devoted to the litchi nut to produce the sugar needed. This will occupy barely six per cent. of our 3,000, 000 square miles of territory, leaving 2,820,000 square miles for homes, schools, churches, factories, emporiums, parks, playgrounds and reservations. There is evidently no danger of a food shortage if we give the noble nut but a chance to protect us against such a catastrophe.

Nut Meals.

Nut meals of various sorts may be made by grinding carefully prepared nut meats in a hand mill set to grind a very coarse meal or samp. Nuts which can be blanched, such as the peanut, almond and the filbert, the latter less easily than the first named. make much the best meal. The shelled peanut is on the whole the best for this purpose. The peanuts should be blanched and carefully assorted, then cooked and dried, after which they may be ground to a moderately fine meal which may be used in many ways. Some favorite uses are, in the making of soups, as an addition to cakes, as a substitute for butter in pie crusts and other shortenings. Almonds, hazelnuts and pine nuts are made into butter without cooking.

Animal Foods

All food comes originally from the vegetable kingdom. The chlorophyl grain of the green leaf is the mystic laboratory in which the lifeless inorganic elements of the mineral world are endowed with life. The green parts of plants are factories in which are woven the living fabrics known as organic substances, of which the actinic rays of the sun constitute the warp, while nitrogen, carbon, hydrogen, oxygen, calcium and other elements which enter into the composition of living things form the woof. Each little chlorophyl grain is a trap which captures sunshine and stores it up in the form of carbohydrates, protein, fats and other food principles to serve as fuel to feed the vital fires which burn within the bodies of animals. Animals cannot originate food; they only utilize food principles which have been produced by plants. In passing through the bodies of animals, food materials undergo changes of form, but are not produced.

Plants are food producers; animals, food users. Food is to the animal what fuel is to the lamp, the stove or the locomotive.

In the economy of Nature, while it is true that muscle tissue is largely used as food by animals, it is clearly evident that its first and primary purpose is to serve for force transformation through food consumption. The only animal substances specifically prepared by Nature as food for animals, are milk and the yolks of eggs, both of which are intended to be used by the infant animal while attaining the development necessary to enable it to gather food for itself.

In the yolk of the egg is found not only fat, protein and a small amount of carbohydrate, but the lime, iron and other salts and vitamins—everything which the young chick needs for the building of blood, flesh and bones. It is a little luncheon provided by Nature to support the young creature during its period of helplessness. Milk is supplied day by day and hour by hour to meet the current demands of the young mammal.

The general acceptance of the false theory that many animals are necessarily carnivorous and that the eating of flesh by some animals is a necessary part of the general scheme of living things, naturally led to the supposition that certain plants might also be carnivorous; but it appears from recent observations made by Du Bois that the belief that some plants are carnivorous is a myth. Plants do not secrete ferments capable of digesting animal matter. The supposed digestion which has been observed to take place in connection with the insect-catching parts of insectivorous plants is simply a decomposition due to the action of microbes. The products of this decomposition may be absorbed by the plants, but the latter have no part in the digestive process.

Special Characteristics of Animal Foods.

Milk and eggs are animal foods especially adapted not only to meet the needs of young animals in general, but to suit exactly the nutritive requirements of infant animals of the particular species to which the animal producing the milk or the egg belongs; that is, cow's milk is exactly suited to meet the needs of calves. Goat's milk is different and is adapted to kids. The milk of the dog or of the seal is still different, and is precisely adapted to the young of these animals. A young animal may be raised on the milk of an animal of another species, but not without considerable difficulty and risk, and not infrequently the experiment is a failure. Of the 300,000 infants who die in the United States annually not less than nine-tenths are bottle-fed infants, a fact which bears eloquent testimony to the inferiority of cow's milk to human milk for human infants.

The yolk of an egg is a complete foodstuff, and is easily digestible; whereas, the white of egg in a raw state is almost totally indigestible in the alimentary canal of human beings. Eggs are poisonous to some people. Cooking, however, to a large degree lessens this toxic property of eggs.

Of the three sorts of animal foodstuffs, milk, eggs, and flesh, milk is the only one that contains any appreciable amount of carbohydrates. In cow's milk, about one-third of the total solids consists of lactose, or milk sugar, a wholesome carbohydrate, although one which is utilized with much greater difficulty than any other of the sugars. Cow's milk is almost totally lacking in iron, while flesh foods are equally deficient in lime. The yolk of the egg is well supplied with both lime and iron. Milk and egg yolks furnish a rich supply of vitamins. Meats are very deficient in vitamins for the reason that in animals the vitamins are chiefly stored in the liver and kidneys, just as the lime is almost wholly stored in the bones, leaving the lean flesh, the part commonly eaten as food, almost wholly deficient in vitamins as well as lime, two highly important food principles.

Food iron, another essential food principle, is present in meat, but in not nearly so large an amount as is generally supposed. Most of the iron contained in the body of an animal is found in its blood. In the slaughtering of an animal, most of this is lost, the amount left being so small that an ounce of beefsteak contains no more iron than the same weight of garden greens, such as spinach, and only half as much as is found in the same weight of certain greens, as red root or dock.

The only particular in which all animal foods are superior to most vegetable foods is in the amount and quality of the protein which they supply. The protein of milk, eggs and meat is necessarily complete protein; that is, it contains all the elements (amino acids) essential for the building of animal tissues.

Most vegetable proteins are incomplete, although there are many vegetable products, such as almonds, peanuts, soy beans, and probably many more not yet discovered which contain complete proteins.

The protein of grains and of most of the common staples which have been selected for human consumption, are incomplete, and it is probable that this is the principal biologic reason why meat has come to be considered an essential part of the dietary in cases in which grains are the chief food staple. The lack of knowledge of this fact has been the principal cause of failure in some attempts to live on a diet consisting exclusively of vegetable foodstuffs. It is possible, however, to select from the vegetable kingdom, a complete and satisfactory diet as has been abundantly proven by McCollum, Hindhede and others. It must be admitted, however, that the present supply of vegetable foodstuffs containing complete proteins is not sufficiently large to furnish the great population of the world with a sufficiency of this essential element.

We are glad to be able to say at once, however, that it is not on this account necessary to resort to the use of flesh foods, for, as McCollum and Sherman have abundantly proven, milk is even better adapted than is meat to complement the proteins of vegetable foodstuffs. It will not only supply its own complete proteins, but will furnish elements necessary to render complete the proteins of other foodstuffs to which it is added.

Eggs also are an important and competent source of complete proteins. And so we are not compelled to resort to the use of flesh foods for our essential supply of complete proteins, although it is important that care should be taken to make certain that the dietary is not deficient in this essential element. This may be accomplished even when the dietary is otherwise exclusively vegetable by the inclusion in the daily bill of fare of milk to the amount of 16 to 20 ounces. With a diet of cereals, such as corn, the addition of ten per cent of milk protein (Sherman) is found to be sufficient to render all the protein available.

MEATS

Flesh foods are not the best nourishment for human beings and were not the food of our primitive ancestors. They are secondary or second hand products, since all food comes originally from the vegetable kingdom, being the product of the magic chemistry of the chlorophyl grain. There is nothing necessary or desirable for human nutrition to be found in meats or flesh foods, which are not found in and derived from vegetable products.

For these reasons we think it not necessary to devote more than limited space to the description of meat products, especially as these inferior foods receive in most works on foods and dietetics a very liberal and undue amount of attention.

The World War made clear to all competent authorities on human feeding that it is important to disabuse the minds of the public of the erroneous but deeply seated notion that meat is an essential article of food and to lessen the consumption of flesh foods.

The International Food Commission which met in London, Rome and Paris during the World War was without doubt the most authoritative body which ever met to consider the subject of human nutrition. At its Paris meeting the question of a minimum meat ration was discussed by the commission, but it was decided to be unnecessary to fix a minimum meat ration *"in view of the fact that no absolute physiological need exists for meat, since the proteins of meat can be replaced by other proteins of animal origin, such as those contained in milk, cheese and eggs, as well as by proteins of vegetable origin."*

The U. S. Department of Agriculture sends out a circular prepared by C. F. Langworthy, Ph. D., and Caroline L. Hunt, A. B., in which we are informed that "It is of course possible to eat meat dishes less frequently (than once a day), or *to omit* *meat from the diet altogether, for it has been determined that all the necessary protein and energy may be obtained from other materials, if one so desires and the diet is so arranged that it remains well balanced.''*

And yet we are also told that meat constitutes one-sixth of the total food consumed in this country. A large expenditure for an unnecessary foodstuff! We will in time learn to do without it.

''We could entirely dispense with meats without suffering any ill effects whatever.''—E. V. McCollum.

The Iron of Meats.

Meats, fish, flesh, and fowl contain a considerable amount of iron, but it is of an inferior character. An ounce of lean beef contains one fourteenth of a day's iron supply, but of medium fat beefsteak one must eat a pound and a half to get a day's iron ration. And if fish is the sole source of supply, one would needs eat seven and three-quarters pounds to meet his daily iron need. Such quantities of meat would burden the body with a great excess of protein, two to five times the amount needed and safe.

Blood is naturally rich in iron because of the hemoglobin, the special iron-containing element of all animal life. An ounce of blood contains exactly the amount of iron which replaces the daily loss of the body. The red color of meat is due to the blood which it contains, and this is the source of its iron content.

These facts would seem to support the popular idea that red meats possess superior value as blood-making foods; but science does not sustain this view, but supplies evidence to the contrary.

Many years ago when the writer was a medical student at Bellevue Hospital Medical College, a patient was one day brought before a small class of special students of which the late Professor E. G. Janeway was the teacher. The patient was suffering from a very pronounced form of anemia. Under advice of his physician he had been making daily visits to one of the big city slaughter houses to drink a tumblerful of the warm blood caught as it gushed from the cut throat of a slaughtered animal. This he had done for several weeks as many others were doing at that time, but without any apparent benefit. In each glassful of blood the patient had taken six or seven times as much iron as his body needed to make good the daily waste, but no change for the better had been observed; and Professor Janeway remarked that this was the usual disappointing result.

The drinking of blood never became a popular fad, as might have been the case if it had been less repulsive; but the false and useless notion still survives in the use of beef juice and a whole tribe of loathsome nostrums consisting chiefly of blood, such as "Bovine" and its various imitations.

Although the idea that red meat makes red blood is wholly without scientific foundation it is still a common practice by physicians to urge anemic and debilitated patients to eat freely of red meats, roast beef and beefsteak, and to make free use of beef juices. "Salisbury steaks" are now seldom seen or heard of, but beef powders and other meat preparations have in a measure taken their place.

The absurdity of these popular practices becomes fully apparent when the fact is known that science has demonstrated that the iron of the blood and of meat is no more easily assimilited and made into blood than is the organic iron of eggs, milk, and vegetable foods. In summing up the evidence upon this subject Sherman says that the iron of meats is "of distinctly lower nutritive value than the iron compounds of milk, eggs and foods of vegetable origin." The reason for this is apparent. Not long ago the writer when cruising along the Atlantic noted near the shore a stranded vessel that was being torn to pieces by the waves. On inquiry why the extensive quantities of precious materials which were used in the construction of the ship at a cost of many thousands of dollars were not removed and utilized, the answer came back, "Because it would cost more to convert them into usable form than they are worth."

The same thing seems to be true of the iron of flesh. It has been used once and cannot be economically used again. Nature is a great economist and does not let a particle go to waste that can be salvaged. If blood iron could be utilized, there would be no occasion for worry about the iron intake, for practically all the iron waste is from the blood. Some of the blood iron is saved, but a portion cannot be utilized and hence is cast out of the body through the intestines.

To this Sherman adds,—

"In an experimental dietary study made in New York City it was found that a free use of vegetables, whole wheat bread, and the cheaper sorts of fruits, *with milk but without meat,* resulted in a gain of 30 per cent in the iron content of the diet while the protein, fuel value, and cost remained practically the same as in the ordinary mixed diet obtained under the same market conditions." And it is to be remembered that the iron from vegetable sources was not only cheaper in price, and hence more abundant, but superior in quality.

The Lime Content of Animal Foods.

Surprising as the fact may seem, butcher's meat stands near the head of foods poorest in lime salts. Only the tomato, the apple, polished rice, cornmeal, buckwheat flour, hominy and the banana contain less lime than does average lean beef, with its content of only one-fourteenth (.07) of a grain per ounce. The explanation is found in the fact well known to physiologists, that the lime content of an animal body is almost wholly contained in the hard tissues, the bones, less than one per cent of the total being found in the soft parts. Blood contains even less than lean meats,—only one-twentieth of a grain to the ounce.

It seems to the writer quite evident that the flesh of animals was not designed by Nature for the food of other than carnivorous animals, if indeed it was originally designed for them. And other food essentials besides lime are lacking in the flesh of animals. The vitamins are present only in small and inadequate amount in animal flesh, but are found in abundance in the marrow of bones and the liver. Carnivorous animals eat the bones and the liver as well as the fat and lean tissues of the soft parts. Men, when compelled to live upon a carnivorous diet, likewise find it necessary to eat bones, bone marrow and liver, as pointed out by Stefansson, the eminent Arctic traveler.

Fish contains a larger percentage of lime than does the flesh of warm blooded animals, nearly twice as much, in fact, but the lime content of fish is only about equal to that of white bread, which is very poor in this element.

It is interesting to note in this connection the fact that in vegetable foods the iron and lime are associated with the protein content while in flesh foods the iron is almost exclusively confined to the blood and the lime to the bones. Animal fat, like other fats, is wholly lacking in lime, hence fat meat contains less lime than does lean meat.

It is evident, then, that a high protein diet, especially a meat diet, is not indicated in conditions characterized by a deficiency of lime. Indeed, there is reason to believe that such a diet, by increasing the acid wastes of the body, may cause an undue loss of lime, and so aggravate a condition which needs to be relieved.

Beef.

The lean flesh of the ox and other animals consists almost exclusively of muscular tissue. There is usually more or less fat mingled with the muscular fibers, and in fat animals the muscular tissue is often thickly overlaid with fat.

The popular idea that beef is the most strengthening of foods has no scientific foundation. In order to enter into the composition of the body, meat, like other foodstuffs, must be reduced to amino acids, the building stones which are identical whether of vegetable or animal origin.

Suet, the fat of the ox, has a higher melting point than the fat of other animals except the sheep, as well as of most vegetable fats and hence is less digestible.

Beef is not infrequently infected with the young of a variety of tapeworm, being the principal source of infection by tapeworm.

As offered for sale in the markets fresh meat is always swarming with putrefactive bacteria, among which is the deadly Welch's bacillus, the cause of gas gangrene. These bacteria are present in countless numbers, the count usually reaching 15,000,000 to 100,000,000 to the ounce. Milk containing one-tenth as many harmless sour-milk germs or water containing one-thousandth part as many germs of any sort would be condemned at once. ''Meat bacteria'' are a cause of appendicitis and colitis.

Mutton.

Mutton is equally as digestible as beef and equally nourishing. It is perhaps somewhat less subject to disease than is the flesh of the ox, but from a hygienic and nutritive standpoint the difference between the flesh of the sheep and the ox is immaterial.

Goat.

The flesh of the goat is much like that of the sheep. It is more highly flavored.

Venison.

The flesh of the deer resembles that of the sheep and the goat though differing in flavor. In general, so long a time elapses after the death of the animal before it reaches the consumer that its flesh has reached an advanced stage of decomposition. It is this which gives to the flesh of wild animals its high or gamey flavor. Such flesh is reeking with infectious germs.

Pork.

Pork is generally recognized as being less wholesome and less digestible than most other meats. Its use was forbidden to the Hebrews by Moses, and the injunction of the great law giver is strictly observed by Mohammedans, as well as by orthodox Hebrews, even at the present day.

Swine are much more likely to be infected by parasitic diseases which are transmissible to human beings than are sheep and beeves for the reason that they are omnivorous. Their scavenger instinct even leads them to consume putrefying dead animals. The country slaughter house always has a pig pen behind it into which the offal of slaughtered animals is thrown to be eaten by swine which are later themselves butchered and sold for consumption by human beings. Not infrequently hogs are fattened on dead horses and other animals which have died of themselves or have been killed for the purpose. It is well recognized that the flesh of hogs fattened upon the flesh of other animals has a strong and offensive flavor resembling that of the dog, lion, and other carnivorous animals. The scientific stock raiser insists that hogs should be fed exclusively upon clean, wholesome vegetable foods. There is certainly no doubt that the flesh of hogs fed upon flesh is much inferior to that of animals fed upon a clean vegetable diet. From which it is an easy inference, which seems to be overlooked by most writers on dietetics, that if flesh eating will have the effect to render the tissues of a hog inferior and reeking with bad odors and flavors, flesh eating by man must produce a similar effect upon his tissue. Can tainted tissue be healthy?

Fowls.

The flesh of fowls, particularly chicken, is highly esteemed by meat eaters because of its flavor, and many persons suppose the flesh of fowls to be more wholesome than beef, mutton, and other meats. As a matter of fact, there is practically little difference in the wholesomeness of the different sorts of meats, fish, flesh, and fowl. The principal objection to meats of all sorts is the fact that the undigested residues readily undergo putrefaction in the colon, giving rise to autointoxication. All meats contain when eaten putrefactive bacteria which readily grow in the colon, producing toxins, ptomains, and autointoxication as the result of the absorption of these putrefaction products. White meat of fowls, once supposed much more wholesome than red meats, is now known to have no superiority whatever over beef, mutton and other red meats. Von Noorden has shown by careful analyses that the amount of uric acid and other extractives found in white meats is as great as that found in red meats and sometimes greater.

Fish.

Professor Dujardin-Beaumetz, an eminent French physician, many years ago called attention to the fact that fish are less wholesome than other meats for the reason that they so readily undergo putrefaction. Within a very short time after a fish is removed from the water, the putrefaction processes are far advanced. This is probably due to the fact that most fish are carnivorous so that their bodies are continuously charged with the products of putrefaction. It is probably this fact, also, which gives rise to the peculiar fishy flavor which is characteristic not only of fish but of birds which live largely upon fish. An eminent authority on dietetics calls attention to the fact that "people who subsist largely upon a fish diet have a peculiar rancid odor." Skin diseases are often aggravated by a fish diet, and not infrequently nettle rash and other skin eruptions occur whenever fish is eaten. Certain forms of asthma have been traced to the eating of fish, also certain parasites, to which fish are very subject.

"Sea Foods."

Lobsters, crabs, oysters, and other sea foods are all scavengers in their habits, subsisting largely upon the animalculae found in the ooze and slime which cover the stones and weeds found in the waters where these creatures thrive. Lobsters and crabs are notoriously hard of digestion.

Oysters.

The oyster has been thought to be one of the most innocent of foods. Raw oysters, stewed oysters, oyster broths, and other preparations of oysters are not infrequently recommended by physicians for the use of persons whose stomachs are supposed to be too delicate to digest ordinary food. But the oyster does not deserve its good reputation. Beaumont's experiments showed that stewed oysters are difficult of digestion, remaining in the stomach for three hours, whereas boiled rice leaves the stomach within an hour, stewed or cooked fruit, such as baked sweet apples, nearly as soon.

The idea that the oyster aids digestion by virtue of its own gastric secretions is a most ridiculous and fanciful theory.

If the oyster lover would take a look with a microscope at the juice of the oysters which he swallows with so much complacency he would hesitate before risking the slimy morsel down his throat. The oyster is a scavenger; he dines on germs. His body is covered and filled with bacteria of various sorts, and the slimy juice in which he is immersed is simply alive with wriggling germs of various descriptions.

A few years ago a paper by Hindman and Goodrich, of the University of Washington, published the results of an extended study of the bacteria of oysters and oyster juice, which showed from one hundred to two hundred million bacteria to the teaspoonful of juice. These bacteria were not of the innocent kind such as those which produce sour milk, but were gas-producing organisms of the sort which cause putrefaction. These pernicious organisms were found in great abundance, in one series in 23 out of 24 specimens. In another series the gas-producing organisms were found in all but one of 22 specimens.

The raw oyster, from a sanitary standpoint, is certainly one of the most unclean things that comes upon the table and may rightly be regarded as quite unfit for human consumption under other conditions than those of emergency and dire necessity.

Typhoid fever epidemics and outbreaks of other intestinal disorders have in many instances been traced to the use of oysters gathered from sewage polluted waters.

Meat Extractives.

According to König, lean meat is 75 per cent water, 16 to 24 per cent protein, ½ to 3 per cent fat, .8 to 1.9 per cent ash, .5 per cent extractives.

The meat solids contain 9.6 per cent of hemoglobin and blood albumin, and 13.7 per cent extractives.

The extract of meat contains a large variety of tissue poisons, among which are xanthins, (uric acid) adenin, tyrosin, and leucin, besides 10 or 12 per cent of creatin and creatinin, together with ignotine, novaine, carnitine, vitiatine, oblitine, carnic acid, and numerous other waste products which have been recently isolated by Kutscher.

Roger, the eminent pupil and successor of the famous Bouchard, says of meat extracts, "The toxicity of extracted matters is real. Extracts of meat contain 22% to 25% of salts of potash and 10% to 15% extracted matters. Their ingestion, even in moderate doses, produces intestinal disturbances, notably diarrhea. Dogs fed with extracts of meat die more rapidly than dogs which receive nothing at all. A person in health may use extracts of meat in small quantities, but *it is necessary to prohibit meat extracts for invalids.*"

The Poisons of Meat.

The tissues of all animals contain poisonous materials, the products of the vital activities which are constantly taking place in all living beings. The activities of the tissues result in the formation of special toxins, fatigue poisons, and toxic residues which are more or less imperfectly removed from the tissues by the blood during life and carried to the kidneys and other excretory organs to be discharged from the body. The formation of these poisons is in life so rapid that it is only necessary that their elimination should be suspended a short time for fatal results to develop. On the death of an animal, as soon as the heart ceases to beat, the removal of these toxins from the tissues ceases; but the development of toxic matters continues for some time after, until the final moment of actual tissue death when rigor mortis occurs. It is consequently evident that the amount of these toxins found present in the tissues of a dead animal is much greater than that which is found during life. The character of these poisons is to a considerable degree well known. Many of them have long been familiar through the examination of the urine, which is simply an extract of the tissues.

While it is no doubt true that the chief objection to the use of meats of various sorts as a human foodstuff is the enormous quantity of toxins produced by the growth of putrefactive bacteria in the intestine, it should not be forgotten that meats when eaten contain a considerable amount of toxins which are in part the result of putrefaction. This is always true, since meat, as eaten, is always in a state of beginning decomposition. This is inevitably the case for the reason that within a few hours after death the tissues of an animal are found swarming with putrefactive flora, even when the carcass has been kept in a refrigerator. Cold storage delays but does not prevent putrefaction.

The amount of these substances which is found in beef and other meats must be very much greater than exists at any time during the life of the animal. According to the late Prof. Gautier, the world's greatest authority, these substances are found in meat broth in the proportion of about one per cent. or about one-half of the total solid constituents. These extractives, according to Gautier, when taken into the stomach, produce effects "comparable to those of the caffein and thein of tea and coffee."

Says Gautier with further reference to these extractives, "we must not forget that these bases are poisonous." The observations of Gaucher, cited by Gautier, have clearly proven this. A guinea pig weighing one pound died after receiving several subcutaneous injections of *sarcin,* a constituent of meat extract. The animal grew thin and passed a deep yellow albuminous urine and died at the end of fifty days. Another guinea pig died as the result of subcutaneous injection of one and one-half grains of *creatin,* always found in beef tea. The urine was at first a deep brown and slightly albuminous. Later, complete suppression of urine supervened and death rapidly followed. Post mortem examination showed death to be due to nephritis.

According to the analyses of Gautier, a *quart of beef tea contains enough creatin to kill nine guinea pigs,* besides potash salts, purin bodies and other substances even more toxic than creatin. When to this we add the fact that the nutrition value of meat broths is practically nothing, according to Gautier only one calory to the ounce, we find ample justification for the assertion of Legendre that bouillon is "a veritable solution of poisons," and the caution of Roger that meat broths and extracts if used at all should be taken only by healthy persons and should be prohibited invalids.

The meat extracts in general use are, if possible, still more objectionable than freshly prepared broths. Fully 20 per cent. of these extracts consist of poisonous substances. So long ago as 1871, P. Muller observed that the addition of an ounce of meat extract to his daily diet produced diarrhea, an evident defensive effort. Two-thirds of an ounce of Leibig's extract of beef added to the regular diet of a dog weighing fourteen pounds produced diarrhea on the sixth day and death from collapse on the ninth.

Meat extracts of all sorts are concentrated preparations of the toxins of meat. They have no nutritive value and their use cannot be too strongly condemned. Meat extracts are, according to Gautier, fifty times as toxic as broth made from two pounds of beef and five pounds of water.

Viscera Highly Objectionable.

The viscera of animals must be looked upon as the most objectionable form of flesh food. All the viscera contain xanthin or uric acid in large amount. Gautier says of the spleen, "this flesh is only a very bad aliment," and of the kidneys, "these organs are bad when they come from old or carnivorous animals." The fact that the kidney of the carnivorous animals is always so bad as to be condemned as food naturally leads one to the conclusion that a flesh diet is not conducive to the health of the kidneys. Sweetbreads, according to Hall, contain seventy grains to the pound of potential uric acid. Blood has from the earliest ages been considered unfit for use as food by the most enlightened nations. The orthodox Hebrew still obeys the injunction given, according to the Bible, to Noah: "'The blood thereof which is the life thereof thou shalt not eat of it."

"High" Meats.

When an animal is alive, its muscular tissues are almost as tender and fragile as jelly; but after death stiffening or rigor mortis occurs as a result of the coagulation or clotting of the muscular tissues, the tissue becomes tough and it never becomes tender again until putrefaction occurs. It is for this reason that meat is allowed to hang for some time after killing to "ripen," in other words, to decay.

Experiments reported by Farger and Walpole (*Journal of Physiology and Pathology*) show that putrid meat contains many poisonous substances, some of which cause rise of blood pressure. It is for this reason that the up-to-date physician forbids the use of meat by persons suffering from apoplexy or arteriosclerosis or from high blood pressure. This restriction is necessary not only because of the poisons which meat always contains from putrefaction which has already taken place, but because of the further putrefaction of undigested remnants of the flesh which takes place in the lower part of the small intestine and the colon.

Gaspard demonstrated in 1822 the toxic nature of putrefying substances. He showed that putrid substances contained poisons which were much more deadly than the excretory products of the body.

Bailey (Fitch, Dietotherapy) very wisely calls attention to the danger of eating high meats as follows:

"The habit of hanging game until it gets *high* is quite objectionable and decidedly unhygienic. When it is hung up for this purpose and allowed to become malodorous, putrefaction is already well under way. This process of decay not only leads to decomposition and the development of toxins, but is a genuine hotbed for microorganisms which may cause gastric troubles and enteric disorders. Such practices, which are bound to endanger the health even of the most robust, should be condemned.

"High game, on account of the toxic substances it contains, is even more dangerous to the circulatory system; the toxins contract the small blood vessels and thereby put extra work upon the heart. For this reason, in critical cases of cardiac affection and high blood pressure and in Bright's disease, it should not be eaten.

"When meat is stale or game high it is positive evidence that putrefactive changes have taken place by bacterial action, whereby certain alkaloidal substances of the nature of ptomains and leucomains of an exceedingly poisonous nature are formed. When such food is ingested and absorbed, serious and even fatal results often follow."

The eating of putrid flesh is always dangerous; in certain cases immediately so; in others, the injury appears later. Decaying flesh is always infested with germs which produce "gas gangrene," suppuration, peritonitis, pneumonia, abscess and other deadly disorders. When introduced into the intestine, these germs fix themselves upon the intestinal wall and become permanent inhabitants which are even more difficult to get rid of than Canada thistles in a pasture lot. They take deep root and spread. They invade the appendix and cause appendicitis. They cover the walls of the colon and cause colitis. They work through the wall and produce adhesions, even inflammations of kidney and bladder. They work slowly upward in the small intestine and finally reach the gall bladder causing gallstones. They may be the cause of gastric or duodenal ulcer. They become a serious menace to the entire body through the poisons which they form, some of which are as deadly as the virus of snakes. The writer has met many cases in which a single meal of cold storage chicken or duck or other game, long dead and neglected to be buried, has been the cause of many years of misery and invalidism.

Pezard, a French investigator, has shown that an exclusive flesh diet in cocks causes degeneration and atrophy of the genital glands with the usual effects of castration. Chalmers Watson made similar observations.

Putrefaction Products in Meat.

The popular practice of keeping meat until it becomes prime, or ripe, is in the highest degree reprehensible. It is important that the fact should become well known and understood that this so-called process of "ripening" is in no way different from the process of putrefaction. It is, in fact, putrefaction pure and simple. Whether the carcass of a dead cow hangs in a meat market or lies neglected in the corner of a pasture lot, the changes which take place in the tissues of the animal are precisely the same. Decomposition begins within a few hours after death, and progresses more or less rapidly according to the temperature to which the body of the animal is exposed. At a low temperature (40° F.) decomposition proceeds slowly, but nevertheless it proceeds. The character of the bacteria which develop at a low temperature are somewhat different from those which grow at a high temperature, but toxic products are produced in both cases. Says Roger:

"Flesh and meats kept for a length of time undergo the influence of bacterial growths, changes which render them toxic. . . . The digestive tube of man is much more sensitive to these poisons than that of animals. . . . Meats which are slightly putrid produce in human beings gastro-intestinal disorders, while perfectly well tolerated by carnivorous animals, and even by animals which are not naturally carnivorous."

Spallanzani fed rotten flesh to pigeons apparently without immediate ill effects, and Roger made a similar observation on guinea pigs. It is quite possible, however, that if the experiment were continued for a long time and more exact observations had been made, deleterious effects would have been discovered.

The worst effects, indeed, are the more remote consequences which result from the continued introduction of these poisons and the germs which produce them in the intestine. To infections of this cause must be attributed, in the writer's opinion, a large portion of the great number of cases of intestinal autointoxication which are now recognized in every civilized country. Professor Brouardel, an eminent French physician, reports a case in which a number of persons suffered seriously after eating of stuffed goose. One of the persons, a woman suffering from chronic disease of the kidneys, died, evidently because the kidneys were not able to cope with the great quantity of enterotoxins which entered the blood from the intestine. There can be no doubt that the lives of many persons suffering from chronic renal and liver diseases are cut short in a similar way. The writer has in mind at the present moment a number of cases in which persons suffering from chronic renal disease have by a single indiscretion in eating a hearty meal of meat brought on a fatal relapse.

"Sausage often contains great numbers of ptomains and microbes; hence if not well cooked it is very likely to cause serious poisoning. Sausage contains all forms of noxious substances." (Roger.)

If sausage does not always contain great numbers of bacteria and great quantities of bacterial poisons, it is only because antiseptics of some sort have been used. Muller reports 265 cases of poisoning from sausage, in which the symptoms generally began after an incubation period of about eighteen hours. The first symptoms were weakness, exhaustion, nausea, vomiting, diarrhea, dryness and burning of the throat. Two or three days later worse symptoms appeared; as vertigo, staggering gait, difficult respiration, double vision, difficulty in swallowing, hoarseness, clammy skin, paralysis of the legs, collapse and death. In some epidemics one-third of the cases are fatal.

"Decomposing meats (comprising practically all butcher's meat), are full of toxins and bacteria which find in the intestines excellent conditions for their development." (Roger).

The poison produced by the bacillus *botulinus* is extremely deadly. Less than one ten-thousandth part of a drop of a culture of this germ was found sufficient to kill a mouse.

"For efficient destruction of the bacteria found in them, meats must be heated to a temperature of 248° F. for two hours." (Roger). This is seldom done, in fact, it is quite impracticable in the ordinary cooking of meat.

"Fish are still more likely than the flesh of other animals to give rise to poisoning." (Roger). This fact has long been known. It was on this account that Alexander the Great forbade his soldiers to eat fish. The tissues of some fish contain a poison similar to curare, the "arrow poison" of certain savage tribes. Certain fish have poison glands, so that their bite is as poisonous as that of a venomous snake. Roger gives a long list of poisonous fish. The late Professor Brieger, as well as others who have made a careful study of this subject, isolated numerous ptomaines which are found in the flesh of fish. Even in a fresh state it is known that sturgeon meat contains various toxic alkaloids. In Russia, where many persons live largely on sturgeon during Lent, poisoning from this source is often observed. Anrep reports the death of five persons from the use of salted sturgeon. Fish become poisonous at certain times or in certain places because of the noxious character of the food on which they live. This is the case with fish living in the vicinity of coral reefs. Cases of poisoning have been noted in France from the use of sardines, salmon and codfish. The so-called red cod owes its color to a chromogenic microbe which is associated with poison-producing bacteria.

Virchow reported an epidemic in which nineteen persons were made sick, four fatally, by eating mussels. Mussels habitually gather poisons from the waters in which they live.

According to Roger, shellfish are a dangerous diet. He says: "Even healthy mussels are not a good food. Their prolonged use seems to be capable of producing chronic poisoning and cirrhosis of various organs. These effects have been observed in the natives of Terra del Fuego."

Typhoid fever germs have many times been found in oysters, and numerous epidemics of typhoid have been traced to their use. Simon reports a case of poisoning through eating of lobsters. Rapin reports an epidemic of severe illness from eating crabs. One of the sufferers died at the end of twenty-three days from symptoms resembling typhoid fever.

All of these creatures—oysters, clams, mussels, lobsters, crabs—are scavengers, and quite unfit for food.

All so-called food animals are liable to infection. According to Littlejohn, in a paper read before the National Tuberculosis Conference of London, based upon the conditions observed in England, 20 to 30 per cent. of cattle are tuberculous. Old milch cows (10 to 15 years) are infected to the extent of 75 per cent. Pigs are infected to the extent of 4 to 5 per cent. Birds, including turkeys, ducks and pheasants, are infected with avian tuberculosis. Sheep, goats and rabbits are rarely infected naturally, but rabbits are very susceptible to experimental infection. Horses are tuberculous only to the extent of one per cent.

In the Middle States of this country cows are believed to be generally infected to the extent of about 10 per cent. The carcasses of these tuberculous cattle are usually placed on sale in the meat markets along with other meats.

The Bacteria of Meat.

According to Weinzirl (*Amer. Jour. Pub. Health,* 1914): "The standard of 1,000,000 bacteria per gram, advocated by some as a limit, is apparently too low, since it would condemn nearly all samples of hamburger, when showing no taint or other evidence of putrefaction. *Samples of other market meats, all of which would otherwise pass inspection, often exceed this limit.*

"A bacterial standard of 10,000,000 per gram as the limit proposed, on the basis of which 50 per cent. of the market samples of hamburger would still be condemned. This is justified on the following grounds: (a) Much of it is actually spoiled when it reaches the consumer or is to be cooked; (b) meat teeming with 10,000,000 per gram is potentially rotten and soon will be actually spoiled under ordinary methods of handling; (c) the fact that markets are prone to add sodium sulphite to hamburger, even though the dealer knows it to be contrary to law, indicates that something is wrong with the hamburger; and (d) finally, if hamburger were made from wholesome meat in the first place, then properly iced, it is believed that the bacterial content could readily be held within the 10,000,000 limit."

Ten million bacteria per gram may be said to be equivalent to three hundred million bacteria per ounce. The significance of this will be appreciated when it is remembered that certified milk is not permitted to contain more than 10,000 bacteria per gram, or 300,000 per ounce; that is, marketable hamburger steak may contain a thousand times as many bacteria as certified milk.

Milk which contains as many as 200,000 bacteria per cubic centimeter, or 6,000,000 per ounce, is regarded as unmarketable, and is promptly condemned wherever a meat inspection service is maintained, while at the same time hamburger steak containing fifty times as many bacteria is sold and eaten without protest.

It is to be further noted, that the bacteria of milk consist almost wholly of harmless lactic acid-forming organisms, or sour milk germs, while the bacteria of meat consist almost exclusively of putrefactive organisms such as the Welch bacillus, the cause of gas gangrene, the bacillus putrificus, the bacillus proteus and other bacteria which are usually present in carrion or putrefying animal bodies.

According to Bailey "the bacillus putrificus coli is present in the colon of animals and contaminates all meats. The spores of this bacillus are killed by exposure to a temperature of 224° F.

for 15 minutes; 230° F. for 10 minutes; 240° F. for 5 minutes. In the process of canning meats, if these temperatures are not maintained, the meat in the interior of the can is not sterilized. This gives the bacilli an opportunity to develop and decompose proteins and other organic compounds. The sulphur generated by decomposed proteins forms a sulphid of iron which blackens the tin, while the generated gas may cause the end of the can to be "blown" or "swollen."

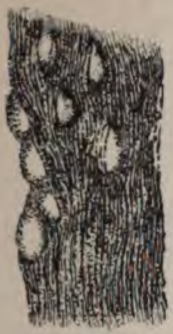
A research carried on by the Meat Committee of the Food Investigation Board of Great Britain has shown that the fungus which produces black spot on cold storage meats will grow at a temperature 9 degrees below freezing. Numerous other molds have been found which grow well at the freezing point.

It remains further to be said that all fresh meat is eaten in a state of decay. The process may not have proceeded so far that the dull human nose can discover it, but a carrion bird or a carrion fly can smell it from afar and various scavenger creatures will quickly show their appreciation of the unsavory tid bit if the arch scavenger man does not get the start of them by an hour or a day. Indeed, the putrefactive bacteria always found in meat in countless numbers, smoked and salted meats as well as fresh meats, are scavenger parasites which play in nature the important role of reducing back to the soil the dead bodies of animals. Another and quite different class of bacteria perform this office for plants.

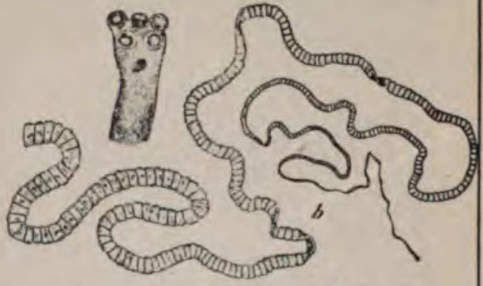
It is evident, then, that all flesh, as eaten, is to some degree unsafe. Ordinary cooking does not destroy the germs of meat. They are killed only by a temperature of 240° F. The usual cooking temperature is less than 212°. Even roasting will not destroy these germs for the oven heat does not penetrate to the interior of the "roast".

Acidosis from a Flesh Diet.

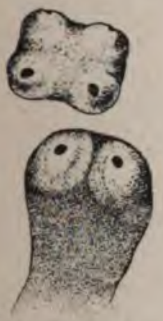
Gautier calls attention to the fact that oxalic acid and other poisonous acids are among the products of the oxidation of protein in the body. "On a flesh diet these toxic bodies accumulate and acidify the blood, excite the heart and intoxicate the subject, disturbing the functions of the skin, lungs, liver or kidneys." "Oxybutyric and other oxyacids," says Gautier, "appear to be derivable from a direct or indirect splitting up of the albuminoids. . . . Oxybutyric acid and oxalic acid are toxic, acidifying the



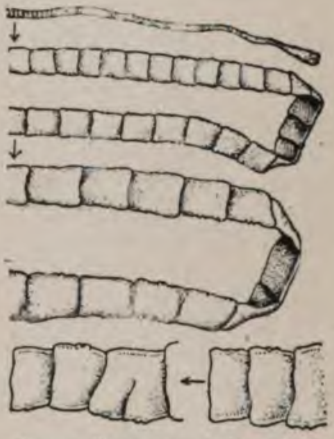
A Piece of Meat Infected with Pork-Measles.



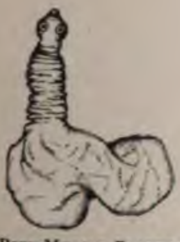
Pork Tapeworm, Head Highly Magnified.



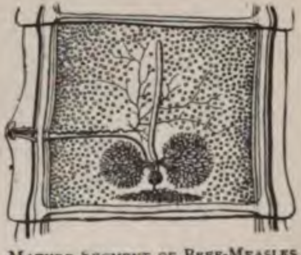
Head of Beef-Measle Tapeworm.



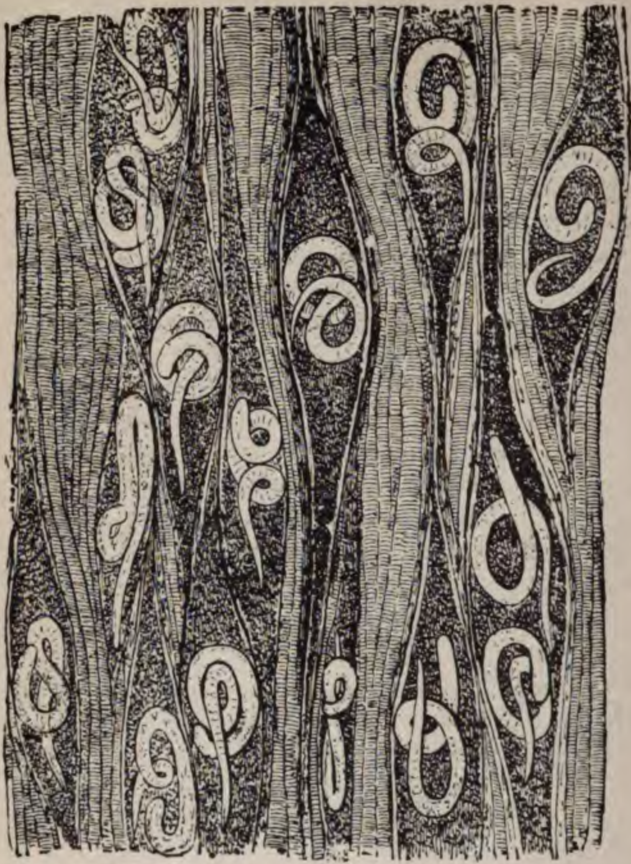
Several Portions of an Adult Beef-Measle Tapeworm.



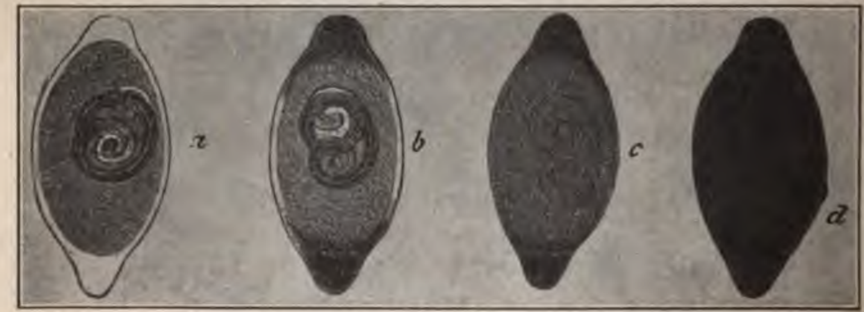
Pork-Measle Bladder Worm.



Mature Segment of Beef-Measles Tapeworm.



Trichinæ in Muscle of Hog. *(Leuckart)*



Trichinæ in Capsules Undergoing Calcification. (a) Not Calcified. (b) Calcification beginning. (c) Calcification further advanced. (d) Calcification completed. *(Ostertag)* fluid of the body and preventing the action of the oxidizing ferments which require an alkaline medium. Hence, there is a veritable acid cachexia acidosis, the origin of joint disease, arthritism and a large number of diseases due to retarded nutrition."

Effect of Flesh Eating on Animals.

Hunter, in experiments to determine the effects of meat eating upon animals (rats), found that a flesh diet, as compared with a bread and milk diet, caused a great concentration of the urine with strong odor; the stools were dark colored. Examination of the animals after death showed in the meat-fed animals, hypertrophy of the kidneys, which was very pronounced in the second generation. The effects produced were like those caused by toxins and were considered to be the result "of a special strain on the functional activity of the kidneys," due to the increased work required to excrete the great excess of protein.

The reason for this is clearly shown by the composition of the extracts derived from meats, the so-called meat extract, some of the poisons of which are present in normal tissue while others are the products of putrefaction.

Parasites of Meat.

Ambrose Paré, the famous French Surgeon, long ago gave the advice that meat should be boiled to kill parasites, but his warning has usually been neglected.

According to Stiles, Professor of Zoology, United States Public Health Service, "Every animal used for food has in its intestines either protozoa, round worms, flukes, or tapeworms. Some of these parasites, especially certain protozoa, are mere scavengers in the intestinal tract, but many of the infections undoubtedly do more or less harm to their hosts. Accordingly, academically these animals are diseased." . . .

"If all animals harboring animal parasites are to be construed as diseased in the sense of the food laws, as they are undoubtedly diseased from the abstract academic point of view, it is clear from the zoologic point of view that no meat can be sold legally."

The Professor's view is that although an animal may be diseased it should not be condemned as unfit for food unless it is diseased in such a way as to cause disease in the eater. In illustration he adds, "When a meat dealer sells pork he is selling a product which in its raw state is dangerous to health for the reason that it frequently contains certain disease germs, trichinae, the absence of which cannot be guaranteed by any practical and proper method of meat inspection known. *If the pork is properly cooked* or otherwise prepared, these germs are killed, are rendered harmless and do not *per se* render the pork diseased, (as food) for if dead they cannot produce disease."

The record of the Bureau of Animal Industry shows that in the year 1908 the meat and meat-food products condemned amounted to nearly three-fourths of one per cent. of the total amount examined.

Half the people of the world eat very little meat. According to Report No. 109 of the U. S. Department of Agriculture, the total production of the principal meats, beef, mutton and pork, of the whole world, excluding China, is about 50 billion pounds annually, which makes the per capita consumption of meat for the people of the world, excluding China, 11 pounds per annum, or less than 9 pounds if China is included.

Evidently, meat plays really a small part in the world-wide scheme of human nutrition.

Flesh Meat Not Essential.

Professor Alonzo E. Taylor contributed some years ago (1911) to the *Popular Science Monthly* an article on "Vegetarianism" in which he says, with reference to a non-flesh dietary:

"Is a vegetarian diet physiologically correct, adapted to the best purposes of a normal life, endurance and longevity? We receive a reply couched in no uncertain terms. Yes, a properly selected and prepared vegetarian diet meets completely the highest requirements of the diet."

In confirmation of the above, Professor Taylor adds, "purely physiological and chemical data, abundantly sustained by laboratory researches and animal experimentation, confirm as well as elucidate the now widely made human experience that a properly selected and prepared vegetarian diet is a complete diet for all conditions and periods of life, beyond the lactation term of infancy."

After admitting the entire adequacy of a non-flesh dietary, Professor Taylor suggests that such a dietary is not practical at the present time for the reason that, "the area of the earth's surface now under cultivation could not, with the present methods of agriculture, dependably produce enough plant albumin to meet the present needs of the population."

The last statement must have been made without consideration, since it requires only a very simple calculation to show that the more than 4,000,000,000 bushels of cereals produced in this country every year contain more than five times enough albumin to supply 2.2 ounces for every man, woman and child composing the 115,000,000 of our present population. With this fact established, it cannot be denied that Professor Taylor has clearly shown not only that a non-flesh dietary is adequate to meet all human needs, but also that flesh foods might be at once, and permanently, eliminated from our national bill of fare without risk of injury to the national health.

We quote the following from, "Food in War Time," by Dr. Graham Lusk, the eminent physiologist:

"If one takes milk with other foods, meat may be dispensed with. Thus Hindhede advocates as ideal a diet consisting of bread, potatoes, fruit and a pint of milk. Splendid health, both of body and mind, the peasants' comparative immunity to indigestion, kidney and liver disease, as well as an absolute immunity to gout, is the alluring prospect held out by the following dietary:

Graham bread..........	1 pound
Potatoes	2 pounds
Vegetable fat............	¼ pound
Apples	1½ pounds
Milk	1 pint

"This bread-milk-potato-fruit diet gives a very excellent basis for wholesome nutrition."

"The question is, is meat necessary? The description of the Italian dietary answers this in the negative."

Mr. Chester Holcomb, in his work "The Real Chinaman," thus describes the ordinary diet of the Chinaman:

"Their daily food consists of rice steamed, cabbage boiled in an unnecessarily large amount of water, and, for a relish, a few bits of raw turnip, pickled in strong brine. When disposed to be very extravagant and reckless of expense, they buy a cash worth of dried watermelon seeds, and munch them as dessert. . . . The description answers with entire accuracy for the food consumption of the great masses of the Chinese people—not for the beggars or the very poor, but for the common classes of industrious workingmen and their families, whether in the great cities or in the rural districts. . . . The only luxuries of which they dream are an ounce or two of meat at very rare intervals with their invariable food of rice and cabbage. . . ."

In a Consular Report by Horton, in 1908, the diet of the native of Greece, is thus described:

"At night the family dines on a few cents worth of rice, boiled together with wild greens and olive oil, and bread, or wild greens boiled in olive oil and eaten with bread or some similar inexpensive dish. Meat is eaten by the laboring classes as a general thing three times a year, Christmas, Easter and the so-called 'Birth of the Virgin.' Such a family as I am describing, the average laboring man's family of Greece, rarely if ever see such things as butter, eggs and milk.

According to Tibbles, "It has long since been stated that no long lived person is a large consumer of meat; on the other hand, that a small consumption of meat tends to longevity, providing the amount consumed does not fall so low as the amount of protein disintegrated and excreted during starvation."

This will never happen if one eats the ordinary amount of bread and adds a glassful of milk each day.

Sir Herman Weber says: "Few people know how little food is necessary in advanced age to maintain bodily health. Few people who live to more than eighty are large eaters of meat."

William Cullen Bryant, one of the most notable literary lights of the nineteenth century in this country, wrote in 1837 to his friend, the Hon. John Bigelow, to whose son, Mr. Poultney Bigelow, the historian, we are indebted for the information, "I accustom myself to the greatest simplicity of diet—renouncing tea, coffee and animal food" (flesh food), a practice which he followed for many years until he died, still in full vigor of health and usefulness, not from disease but as the result of an accident.

From the above paragraphs, it is evident that it is possible for human beings to be sustained in health and vigor with the practical exclusion of meat and even eggs from the dietary. It is important to note, however, that grains enter very largely into these meatless dietaries. These furnish an adequate supply of protein if supplemented by a daily half pint of milk or a handful of nuts.

Greens are also an essential part of the biologic fare, with potatoes and other tubers and roots. These supply lime, iron and alkaline salts which are essential to good nutrition.

E. V. McCollum states "that the greatest thing that can be done to raise the standard of health in this country is to change the type of diet in most homes by decreasing the consumption of meat and increasing the consumption of milk and green vegetables."

Meat Unnecessary.

The late Dr. Pavy, the most eminent authority on dietetics of his time, writing so long ago as 1874, remarks,

"Many people seem to look upon meat almost as though it formed the only food that really nourished and supplied what is wanted for work." In disproof of the correctness of this popular view, Dr. Pavy refers to the report of Dr. E. Smith, according to whom, "it is not uncommon to find, amongst the agricultural laborers of Scotland, that no meat is consumed, oatmeal and milk forming the staple articles of diet. Further, Dr. Guy, from his observations in the case of English prisons, gives as one of his deductions, 'that we possess conclusive evidence of the sufficiency of a diet from which meat is wholly excluded, and even of a diet consisting wholly of vegetable matter.' "

Pavy further states that "animal food certainly taxes the stomach more than the ordinary forms of vegetable food that we consume, as is well known by those who have weak digestive power."

According to Leibig, "A bear kept at the Anatomical Museum of Giessen showed a quiet, gentle nature, so long as he was fed exclusively on bread, but a few days' feeding on meat made him vicious and even quite dangerous. That swine grow irascible by having flesh food given them is well known—so much so, indeed, that they will then attack men."

Baeltz, a German army surgeon, made an interesting observation on the Japanese laboring man, which he thus described:—

"I had two jinrikisha-men; two powerful young fellows, one twenty-two, the other twenty-five years of age. They had followed the same calling for years. I provided their food, which was exactly measured, what they ate, and what they drank; and the chemical composition of the food was ascertained by recognized means. These men received definite instructions:—Every day for three weeks they had to drag me, a man weighing 80 kgs. (176.4 lbs.), a distance of 40 kms. (24.84 miles), running all the time. That appears to be a fairly arduous task—but not more so than that which these men would have willingly undertaken. But for my purpose it was quite enough; for we considered a walking expedition of 40 kms. as something quite respectable; but for a man to run 40 kms. every day throughout a sunny August is rather more than one would usually expect of us.

"Now the men, during the experiment, kept to their usual diet, which contained fats amounting to less than half that proposed by Voit, while the contained protein fluctuated from between 60 to 80 per cent. of his postulate. Carbohydrates, on the other hand, were provided in exceedingly large quantities, in the form of rice and potatoes, barley, chestnuts, lily-roots and other foodstuffs peculiar to the country. After fourteen days I weighed the two men. One had not made any change, while the other had added half a pound to his weight. After the fourteenth day I told the men I wished to give them meat. They were delighted, for meat is a luxury to them. I therefore substituted for a part of the carbohydrates a proportionate quantity of protein—not quite so much as Voit demanded, but a considerable amount. The men ate it with avidity; *but after three days they came and asked me to discontinue the meat, and to give it to them only upon the conclusion of their probation, because they felt so fatigued, and could not run so well as before.*"

This is certainly most convincing evidence of the great endurance which may be supported by a meatless dietary. But the suggestion may be offered that the Japanese are a vegetarian race and have been such for hundreds of years and that racial characteristics may be a dominating factor. The answer to this will be found in the following account of a special research by Professor Irving Fisher of Yale University published in Munsey's Magazine, the purpose of which was to determine the comparative endurance of flesh-eaters and flesh abstainers:—

"The flesh-eaters were largely men in training for athletic contests at Yale; the flesh abstainers were such Yale students as I could find who did not use meat, or used it very sparingly, and nurses and physicians of the Battle Creek Sanitarium. Forty-nine subjects were tested. The results of the comparison were certainly surprising, and showed almost conclusively that those who used low protein and little or no flesh, not only had greater physical endurance, but far greater than those who were on a so-called 'training diet.'

"Very few of the flesh-eaters for instance, could endure holding their arms horizontal for more than a quarter of an hour, whereas it was common among the flesh abstainers to hold them for more than an hour, and without as much pain or discomfort as the meat-eaters experienced in half the time. In one case a flesh-abstainer held his arms out for three hours and twenty minutes, and then stopped merely because he had reached a round number of minutes—two hundred.

"One of the most severe tests was in deep knee-bending, or 'squatting.' Few of the meat-eaters could 'squat' more than three hundred to four hundred times, and it was almost impossible for them to walk down the gymnasium stairs, after the test, without falling, so weakened were their thigh muscles. On the other hand, one of the Yale students who had been a flesh abstainer for two years did the deep knee-bending eighteen hundred times without exhaustion, after which he ran without difficulty on the gymnasium track and walked several miles. Another subject, a nurse at the Battle Creek Sanitarium, did the deep knee-bending twenty-four hundred times; after which he proceeded with his regular work without serious inconvenience. Another nurse has recently accomplished the surprising record of five thousand times. One remarkable difference between the two sets of men was the comparative absence of soreness in the muscles of the meat-abstainers after their tests."

Bunge maintains (*Science*) that the great waste of energy when meat is eaten is the result of over-stimulation of the liver which results in over-production of catalase, an oxidizing ferment which causes excessive oxidation or heat production.

Bunge 20 years ago called attention to the fact that "the normal food of the adult should be furnished by the protein and carbohydrates in the proportion met with in the cereals." He also mentioned the fact that Bavarian laborers who do the hardest work live on a diet of flour and fat, and also refers to the investigations of Panum and Buntzen, from which it appears that "even a carnivorous animal can be nourished on cereals and fat." These investigators kept a dog in good health for months on an exclusive diet of oatmeal and butter, and without loss of weight.

Raw Beef not an Antiscorbutic.

It was long believed that the chief cause of scurvy was the use of salt meats, and the belief is still generally held that fresh meat is an antiscorbutic, that is, that the feeding of fresh meat will prevent scurvy.

Vitamin studies recently made by Dutcher and others have demonstrated that watery extracts of raw, lean meat will not prevent scurvy in guinea pigs and will not prolong the lives of these animals when fed on a diet insufficient to prevent scurvy. Orange juice, on the other hand, was found to prevent scurvy when fed either with or without beef extract.

The excuses for the use of flesh foods under any conditions are rapidly disappearing one by one, in fact, at the present time there is left no apology whatever for the use of flesh under any circumstances except the absence of better food.

A well known editorial writer recently (1921) said in a leading newspaper: "Growth of understanding also, regarding the human diet is bound to lead to the use of smaller meat rations as a measure of health. When people learn that individuals do not require large quantities of flesh foods and that eating much meat commonly leads directly to illness, the United States may cease to pride itself on being the "greatest meat-eating nation."

"In spite of government efforts towards enlightenment regarding the care of farm animals during the last sixteen years approximately 1,475,000 cattle have died annually from disease and 1,500,000 from exposure. In 1914, 7,000,000 hogs died from cholera."

According to Armsby, only three per cent. of the corn fed to a steer can be recovered from the edible portion of the carcass of the animal; that is, for every hundred pounds of corn fed to a steer, only three pounds of actual food material can be recovered.

Of food fed to a dairy cow, eighteen per cent., or six times as much food, is recovered as in the case of the steer.

According to Prof. J. Russell Smith, of Columbia University, in the notable work "The World's Food Resources," in the United States and Canada, but especially in the United States, the chief object of agriculture is not to feed men, but to feed beasts. This was true even in the food crisis of 1918. We now raise altogether about 5,191 million bushels of grain, as follows:

1916-1917 AVERAGE.

Corn	2,863	million	bu.
Wheat	643	"	"
Oats	1,422	"	"
Rye	54	"	"
Barley	195	"	"
Buckwheat	14	"	"
	5,191	"	"

"Of this great total the American people ate less than 550 million bushels of wheat when unrestricted, 180 million bushels of other grains, and the total export of grains, 341 million, brought the amount used for human food up to about 900 million. The rest, 4,300 million, went to our four-footed brethren, who outnumber us and whose food requirements, because of their greater size, are several times our own.

"In addition to the grain, they get all of the 85,360,000 tons of hay grown on 54,618,500 acres. (More than ten per cent. of the half billion acres under cultivation in the United States). They also roam over millions of acres, eating all the grass. It is therefore plain that more than four-fifths of the produce of the American agriculture, even in 1918, went to feed the beasts."

Special Contraindication of Flesh Foods.

Albu, an eminent German authority, so long ago as 1901 (Berlin Klin. Woch.) recognized the injurious effects of a flesh diet, especially in maladies dependent upon intestinal putrefactions, and prohibited its use in the following maladies: neurasthenia, nervous disorders of the stomach, hyperacidity of the stomach, mucous colitis, chronic constipation, obesity, exophthalmic goiter, renal diseases, affections of the skin, disorders of metabolism, diseases of the blood, diseases of the gastro-intestinal tract, pruritis, furunculosis, urticaria, erythema nodosum, and the various forms of eczema.

While flesh foods are unnecessary in any case when other food is available, there are many diseases in which the use of flesh foods of all sorts is particularly objectionable because likely to encourage the disease and interfere with the efforts of Nature to accomplish a cure. Among these diseases may be mentioned particularly the following:

All conditions in which there exists a state of autointoxication, because the putrefaction of remnants of flesh foods in the colon is the most active cause of intestinal toxemia.

Constipation, because of the paralyzing effect of putrefactive poisons upon the muscular walls of the colon.

Colitis, a common malady which is caused by the infection arising from the putrefaction of food residues in the colon. Meats contain the bacteria which cause colitis.

Fevers of all sorts and febrile conditions because of the necessity for lessening the work of liver and kidneys as much as possible when the body is struggling against the toxic influence of a temperature raising poison, also because the production of gastric juice is lessened in fever and hence meat is likely to be less well digested and more likely to undergo putrefactive changes.

Hyperthyroidism or Grave's disease, and hypothyroidism or myxedema and other diseases of the thyroid, all of which are greatly aggravated by the poisons resulting from a meat diet and are often due to this cause.

Bright's disease, stone in the kidney or bladder, and other diseases of the kidney, for the reason that the kidney is the chief means of elimination of the poisons arising from meat eating, and the crippled kidney is unable to do the extra work imposed by a meat diet and so is made worse by it. The work of the kidneys is doubled and tripled by flesh eating.

Gout, rheumatism, and all rheumatic affections which are aggravated and often caused by a meat diet.

Pigmentation, liver spots, since the putrefaction of meats in the colon is the source of the brenzcatechin and other poisonous pigments, which, the crippled suprarenal capsules being unable to destroy them, are deposited in the skin.

Acidosis is increased by a diet rich in fat and protein, hence in this condition, and in diabetes and other maladies in which acidosis is likely to occur, meat should be avoided.

In pellagra meat is to be discarded both because it encourages autointoxication, which in this disease is very pronounced, and because foods rich in vitamins are indicated. Meats are very deficient in vitamins.

For the same reason meat is contraindicated in cases of sprue and beriberi, maladies which are very common in Oriental countries and are often brought to this country by travelers or returning missionaries.

High blood pressure, arteriosclerosis, myocarditis, apoplexy and paralysis are closely allied affections in all of which a non-flesh dietary is most necessary.

Cirrhosis of the liver is a crippled condition of a highly important vital organ which demands a fleshless bill of fare as a precaution against a fatal toxemia.

Gallstones, gall bladder disease, jaundice, and hepatic abscess are all conditions which demand the prohibition of meat as a protection of the most important defense of the body against poisons of all sorts, and especially against the poisons produced by germs in the intestines.

Dropsy is an indication of a crippled heart or kidneys in most cases and requires special care to avoid the intestinal poisons produced by a meat diet.

Cancer is a meat-eater's disease. It is common among meat-eating races of men and animals, rare among flesh-abstainers (Williams, Hoffman). A fleshless diet may not cure cancer, but will delay its progress (Bulkley).

Chronic cystitis and disease of the prostate gland are aggravated by a meat diet because of unfavorable changes produced in the urine.

Ordinary or secondary anemia does not require meat when egg yolks and garden greens and a score of other foods rich in iron are available, and do better without meat than with it. Pernicious anemia is made much worse by a meat diet. *The iron of meat is inferior in quality* (Sherman p. 393).

Tuberculosis is aggravated by meat diet. Milk and greens are of special value in this disease, and when these are provided there can be no reason for the use of meats.

Gastric catarrh, like catarrh of the colon (colitis) and of the small intestine (enteritis), requires disuse of meat. A diet of buttermilk aids in starving out the bad flora (Debove).

Bronchial catarrh and asthma are often cured by a change from a high to a low protein ration.

Chronic appendicitis is a meat-eater's disorder. Appendicitis, both acute and chronic, is practically unknown among the vegetable eating tribes of Africa (Senn, Cole).

Skin disorders such as chronic eczema and psoriasis, often incorrigible under every other mode of treatment, rarely fail to yield promptly to a dietary from which meats are rigidly excluded (Bulkley).

Neurasthenia, insomnia, migraine, insanity, epilepsy, and many other nervous disorders are now known to be either due directly to the influence of toxins derived from the colon and circulating in the blood, or at least greatly aggravated by such poisons. The adoption of a fleshless diet certainly exercises a most favorable influence on this class of disorders.

Inebriety requires the total exclusion of flesh foods from the dietary. The effect is often most striking, causing the disappearance of the alcoholic appetite within a few days, or at least so mitigating it as to render control possible (Booth).

Parasitic infections such as malaria and syphilis are favorably influenced by the fleshless regimen. Sanderson, the famous elephant hunter of India, informed the writer that after abstaining from flesh foods he remained free from fever in the jungles, although before he was always attacked with fever whenever he visited the jungle.

Gastric and duodenal ulcer require avoidance of meat because of the fact that flesh foods very probably play a very active part in their causation. "Gastric ulcer is a meat-eater's disease."

Hyperchlorhydria or hyperacidity is greatly aggravated by a meat diet which stimulates the gastric glands to secrete an excess of acid (Pavlov).

In hypochlorhydria and achylia flesh foods are contraindicated because a highly active gastric juice is essential for the digestion of meats. Flesh foods are of all foodstuffs most out of place in cases in which the normal acid of the gastric juice is absent or greatly deficient.

Meats of all sorts should be excluded from hospital bills of fare. The patient who has undergone a surgical operation needs essentially the same diet as a fever patient until and after he reaches convalescence. The common use of beef tea, meat extracts, meat soup stocks and like preparations is in the highest degree unjustifiable in the light of modern knowledge of organic and physiologic chemistry. Such preparations only add to the burdens of the liver and kidneys which in the surgical patient are always heavily taxed, and lessen rather than improve chances for recovery. Constipation, usually very pronounced in surgical cases, renders a meat diet particularly objectionable because of the aggravated toxemia induced thereby and is rendered still more obstinate through the paralyzing influence of the ammonia and other putrefaction poisons produced.

EGGS

The eggs of birds, especially of domestic fowls, are universally used as food by human beings as well as by the anthropoid apes and various other animals. The eggs of the common domestic fowl and the guinea hen are the most delicate and agreeable. The eggs of the duck and goose are richer in fat and of stronger flavor. The eggs of fish-eating birds have a strong fishy flavor and on that account are seldom used as food.

The flavor of eggs is more or less influenced by the character of the food, and on this account much care should be taken in the feeding of fowls.

The eggs of sturgeon and other fish, known as roe, are much used in some countries.

The egg is a highly nitrogenous food. The whole egg affords 15 calories of protein to the ounce and 31.7 of fat, a total of 46.7 calories, or two-thirds that of porterhouse steak and more than double that of milk.

A hen's egg of average size weighs a little less than two ounces. Approximately, the egg consists of one part shell, six parts white, and three parts yolk.

A single egg furnishes about 30 calories of protein. It is evident, then, that four or five eggs supply protein sufficient for an ordinary day's ration. But it is to be remembered that cereals are rich in protein and all vegetables contain some of this element, while milk contains an excess, and supplies in one-half pint more protein than does an egg. A dietary which includes two glassfuls of milk with a sufficiency of other foods not of animal origin, will afford an abundance of protein without the addition of eggs. Even if neither meat nor milk is included in the bill of fare, not more than two eggs at most will be needed to supply all the supplementary protein required for one day.

Milk lacks iron and so is not a complete food; but on account of its great excess of protein, the egg is less suited to serve as an exclusive diet, and should not be too freely used. Its proper place in the dietary is to round out a diet otherwise deficient in complete proteins, vitamins and lime.

As a source of complete proteins, the egg is inferior to milk because less digestible and also because very liable to be rendered unfit for food by putrefaction. Milk ferments or sours when stale, while eggs putrefy. A stale egg is certainly one of the most disagreeable as well as most dangerous of unwholesome foodstuffs, while sour milk is actually more digestible and really more wholesome for most persons than is fresh milk. This property of milk is due to its carbohydrate, sugar of milk, an element which in eggs is lacking.

Egg Yolk.

Egg yolk is a very remarkable substance prepared by Nature for food, and hence contains all the elements necessary for complete nutrition, including a rich store of lime and iron and other salts, with an abundant supply of vitamins. Nothing is forgotten. The yolk is the sole food of the young chick while it is undergoing development in the shell, and when it leaps out of its prison house it is fully equipped to enter upon its life career, and to thrive upon the foodstuffs which it finds ready at hand. It does not have to be nursed or brought up on a bottle. It needs only to eat, exercise, and grow. The yolk of the egg has supplied it with everything needful for its complete life equipment.

It is evident, then, that the egg yolk is a very exceptional food, and naturally one would expect it to be, for the reason that nature has prepared it to serve as a whole bill of fare, capable of supplying everything needful for the development of the animal from embryo to self-support. Nature is no bungler.

It is sometimes well to advise the use of egg yolks alone, excluding the white when the object is to increase the intake of lime salts. The writer has followed this plan for many years.

To insure the utilization of eggs it is highly necessary that they should be properly cooked. Raw eggs are indigestible. Half cooked eggs are half digestible. Fried eggs and omelets are hard of digestion, and the undigested fragments which appear in the stools carry away a considerable part of the precious lime which should be retained and absorbed. This difficulty may be obviated by cooking the egg at a low temperature, 150° to 160° F. Cooked in this manner, the egg is soft and jelly-like or "curdled," and is presented to the stomach in most digestible form. When egg yolks alone are eaten, they may be separated either before or after cooking. Hard boiled yolks are easily digestible, which is not true of the whites.

Egg White.

Raw white of eggs has long been regarded as among the most easily digestible of all food substances. This idea was chiefly based upon the observation by Beaumont in his experiments upon

Alexis St. Martin. Beaumont noted that raw egg white left the stomach very quickly, in less time in fact than any other foodstuff which he investigated. More recent investigations, however, by Pavlov and others have shown that this interpretation of Beaumont's observation is incorrect. Pavlov, for example, showed that the raw white of egg does not stimulate the flow of gastric juice. In this respect white of egg differs from other proteins, the effect of which is to cause the stomach to pour out an abundant supply of a highly acid gastric secretion.

The effect of white of egg on the stomach as observed by Pavlov was the same as that of water. Abderhalden discovered another peculiarity of raw white of egg. He found that this form of albumen is not readily acted upon by pepsin. Okada showed that the intestinal fluids, both the bile and the pancreatic juice, are indifferent to white of egg. Very little bile enters the intestine when white of egg is introduced and trypsin, a digestive principle of the pancreatic juice which acts vigorously upon other protein, has no effect whatever upon raw egg white. Other investigators have confirmed this observation. A still further very remarkable observation made by Vernon, Hetin and numerous other investigators shows that the raw white of egg not only is not acted upon by the digestive fluids but that it hinders the digestion of other substances.

Steinitz noted that raw egg white caused vomiting and diarrhea in dogs. Further investigation has shown that diarrhea is produced and vomiting is frequent. Five egg whites given to a fifteen pound dog caused very severe diarrhea. The stools were not only loose but had an extremely offensive odor and contained a great deal of mucus, indicative of very active putrefaction and marked infection. Even when small amounts of raw white of egg are fed the egg albumen can be recovered from the stools unchanged.

These peculiarities of raw egg white disappear when it is cooked at a temperature of 160° F. At this temperature the egg white is thoroughly coagulated but remains soft and jelly like. Egg yolk on the other hand was found to be very easily digestible when eaten either raw or cooked. Careful experiments have shown that raw egg white has no food value when introduced into the colon and hence it should not be used in rectal feeding. Another objection to the use of raw egg white is the readiness with which this substance is absorbed into the blood, producing anaphylaxis. This objection applies, however, to cooked egg white as well as raw.

The peculiar effect seen in persons who are sensitized against egg is said to be due to ovo mucoid which the egg contains. Egg white contains also three other substances, ovo globulin, ovo albumin and con albumin. Albumin is shown to be the cause of diarrhea. The amount of white of egg required to give rise to anaphylaxis is extraordinarily small. This effect was produced in guinea pigs by less than one-millionth of a grain of egg white.

From the above facts it is evident that the practice of giving raw eggs to invalids with or without milk feeding and the use of white of egg in the feeding of babies are not only valueless but are really more or less dangerous procedures.

Liquid albumin retards the digestion of coagulated albumin, hence partially cooked egg white digests very slowly. This is true with reference to both gastric digestion (Linoissier), and pancreatic digestion (Delezenne).

According to Bayliss, the eminent professor of physiology in the University of London (The Physiology of Food and Economy in Diet), raw white of egg contains some substance which, even in very small amount, interferes with the action of the digestive fluids.

Cooking destroys this substance; but at the same time long cooking renders the white of egg difficultly soluble in the digestive juices, just as large lumps of ice melt less rapidly than finely pulverized ice. White of egg has for centuries been considered almost indispensable for the feeding of the sick and especially the feeding of convalescent surgical cases. Many a nurse will feel that without the time-honored egg nog her ward patients will certainly starve. But the raw eggs must be dropped from the hospital bill of fare and sick room dietaries. In fact, the egg in any form is under suspicion and must be used in moderation and with caution to make sure that it is perfectly fresh and free from infection.

Recent experiments by Rose and MacLeod seem to indicate that the raw white of egg is well digested if lightly beaten.

Professor Linossier, a member of the Academy of Medicine of Paris, holds that there is in eggs a toxalbumen to which some persons are susceptible either by heredity or through acquirement as the result of disorder of the liver or intestines. This poison, according to Linossier is destroyed by heat. Hence, eggs should never be eaten raw, but should be cooked, both white and yolk, to the point of coagulation or curdling. Further cooking lessens digestibility.

The Cooking of Eggs.

According to Penzoldt, the time required for the gastric digestion of eggs cooked in different ways is as follows:

Lightly boiled	1¾ hours
Poached	2½ hours
Hard boiled	3 hours
Omelet	3 hours

When boiled two minutes the white of egg next to the shell is coagulated; the yolk remains fluid. In a three minute egg the white is coagulated and the yolk is thickened. A ten minute egg is hard boiled.

A good way of boiling eggs is to drop three eggs in a quart of boiling water. Remove at once from the source of heat. In ten minutes the eggs will be found to be uniformly soft boiled, or "jellied."

The greenish black color which is sometimes seen on the surface of the yolk of a hard boiled egg is due to the formation of sulphide of iron (Tinkler). If the egg is cooled at once after boiling, the chemical change does not occur.

Influence of Hen's Food on Eggs.

Eggs are greatly influenced by the food of the fowls by which they are laid. Meats and putrefying substances give to eggs a strong flavor. Milk, sunflower seeds, and other clean and wholesome foods insure a very superior flavor.

When chickens have plenty of green feed and yellow corn, the yolks have a much deeper color, due to the presence of carotin which is often associated with the fat-soluble vitamin.

Eggs and Biliousness.

Many persons know by repeated experiences that the free use of eggs produces a well defined physical condition which is commonly termed "biliousness" although, very likely, connected with the bile or bile making function of the liver only in a remote way. "Biliousness" is really acute autointoxication. Its cause is the putrefaction of undigested and unabsorbed protein in the colon and the absorption of the poisonous products of bacterial action. Eggs encourage putrefaction, milk does not.

If the eggs happen to be a little stale, the putrefaction and autointoxication are greatly intensified.

The Food Iron of Eggs.

The iron of the egg is contained almost wholly in the yolk, where it is stored up for use by the developing chick in making its first outfit of red blood cells. The proportion of iron found in the yolk is one hundred times as great as that found in the white of the egg. This is due to the fact that the yolk is food specially prepared for the young chick while the white is the embryonic tissue which is destined, under favoring conditions, to grow and develop into the bones, muscles, nerves, feathers, and other structures of the chick itself. In the case of mammals, the young animal remains connected with the body of the mother until the organs essential to life have been developed, obtaining its food directly from the blood of the mother before birth and indirectly through the mother's milk afterward until able to feed itself.

Professor Bunge found in the egg yolk an iron compound so closely resembling the hemoglobin of the blood corpuscles as to be easily converted into it, and so he gave to the compound the name of *hematogen,* which means, in simple terms, generator of blood. Hematogen contains .3 per cent of iron and yet all the ordinary laboratory tests for iron fail to reveal its presence. This remarkable fact clearly showed that food iron is a quite different thing from the ordinary metallic iron of the laboratory. The deft hand of Nature working in her secret laboratories, has, through the agency of vital activity, lifted the cold inert iron of the mine and the foundry into the realm of organic life, and has endowed it with marvelous properties by enormously increasing its natural affinity for oxygen. Ordinary rusting proceeds very slowly. When the oxygen hunger of iron is fully developed as in the hemoglobin of the blood, this oxygen absorbing propensity operates with lightning rapidity. All the blood in the body, about five quarts, rushes through the lungs every minute or two, and yet the stream is not so rapid that the subtle hemoglobin does not have time to snatch for each tiny red cell its full load of oxygen.

It is well worth while to remember that when eggs are used as a source of food iron, to enrich the blood in anemia, it is the yolk only and not the whole egg that is useful.

As a source of food iron, the egg fills an important place in the dietary, and one that milk cannot fill because of its deficiency in iron. This is true, however, only of the yolk of the egg since egg white contains hardly more than a trace of iron. Two yolks contain as much food iron as a five ounce serving of meat, four times as much as an equal weight of meat, and eight times as much as the same weight of fish.

It is to be said, also, that the iron of the egg yolk is superior to that of meat, being especially prepared by nature to serve as food iron, while the iron of flesh is practically identical with that derived from the dead blood cells of the body, or waste iron which is in large part excreted by the liver.

Here again the green plant shows its superior value as a supplementary nutrient. An ordinary serving of spinach supplies as much food iron as three or four egg yolks and a serving of red root or dock greens as much as half a dozen eggs.

The Lime Content of Eggs.

An egg yolk of average size weighs half an ounce and so contains a little more than 2/5 of a grain of lime (.42 grain) or 2.7 per cent of a day's ration.

A comparison of the lime content of the whole egg, the white and the yolk is both interesting and instructive. The egg yolk contains, per ounce, nine times as much lime as the white. The figures for the whole egg represent the combined composition of the yolk and white.

It is evident that eggs, and especially the egg yolks, are a most valuable source of food lime, but this is not true of the white taken by itself, which contains less lime per ounce than most of the cereals, scarcely more than rice, about the poorest in lime of all the cereals.

As a source of lime, the egg is again inferior to milk, which supplies a much larger amount of food lime than the same weight of eggs. The lime content of a glassful of milk equals that of three or four eggs.

The lime of the egg is mostly found in the yolk, although the unhatched chick absorbs considerable lime from the egg shell. An ounce of egg yolk furnishes more lime than an ounce of milk, but more than ten yolks are required to supply as much food lime as a half pint of milk.

It must be remembered, also, that the green leaf is a most valuable source of food lime. An ounce of chard nearly equals two egg yolks in lime content, and even celery furnishes as much lime as the same weight of yolks, while an ounce of turnip tops supplies as much lime as the yolks of four eggs, and an ounce of mustard greens as much as half a dozen yolks.

From the above, it will be plainly apparent that while the egg is valuable as a source of protein, lime and iron, it is not essential. Milk will supply equally good lime and protein, and the green leaf is a still richer source of food iron.

It is not to be forgotten that the egg is also a source of valuable vitamins, especially the anti-neuritic or beriberi preventing vitamin and the anti-rachitic or fat-soluble vitamin. Both of these food essentials are supplied, however, in rich abundance by the green leaf.

Egg Substitutes.

Egg substitutes are generally unsatisfactory and sometimes unwholesome. They are chiefly used by bakers. The best are made from the casein and albumen of skimmed milk, which are mixed with flour and dried. Others are made from the blood of slaughtered animals and are most unwholesome.

Preserved Eggs.

There is no known means of preserving eggs without deterioration except refrigeration. The Chinese have for ages employed a process of preservation which is not likely to become popular in this country. Fresh duck's eggs are kept in an infusion of tea, lime, salt and wood ashes for half a year, then drained and coated with rice hulls. Eggs thus treated are known as "pidău." Another method of preservation is to encase the egg with a thick layer of plaster of Paris. Eggs preserved in this way have a strong flavor of ammonia.

The popular method of preserving eggs by means of immersion in silicate of soda or water glass is far from satisfactory. Such eggs are not always unwholesome, but they lack the properties of strictly fresh eggs.

In hot weather, eggs will keep perfectly fresh without refrigeration not more than three or four days. A low temperature is nearly as necessary for the keeping of eggs as of milk.

Bad Eggs.

Eggs are not eaten in this country unless supposed to be fresh or well preserved. The decayed egg is rejected at once. The Chinese gourmand, however, has a great penchant for stale eggs. His highly cultivated palate delights in the pungent aroma of an egg two or three years advanced in putrefaction. The American turns in disgust from the stale egg, but curiously enough, requires the same condition in his beefsteak, that the Chinaman demands in his egg.

The flesh of a recently killed animal is tough, the result of *rigor mortis,* or heat-stiffening of the muscles. Living flesh is tender, almost jelly-like, but after *rigor mortis* occurs, it becomes tough and never becomes tender again until made so by putrefactive changes. These changes begin in less than 24 hours after death, and continue at all temperatures above freezing. This is the reason that cold-storage meat "goes down" so rapidly when exposed to ordinary temperatures.

Fresh milk and fresh eggs are, on this account, highly preferable to meat as sources of animal protein, but have further advantages. Eggs contain lime and iron in rich abundance, and in forms easily assimilable, whereas meat is almost wholly lacking in lime and *its iron is inferior* (*Sherman*) see p. 493. Milk is rich in lime salts and both eggs and milk are rich in essential vitamins.

It was formerly supposed that if the fresh egg were kept free from contact with bacteria it would remain sterile, but since the investigations of Rettger it is known that quite a large proportion of all eggs show bacteria when carefully examined. This is especially true of the yolk of the egg, which is infected much more often than the white. According to observations made by the U. S. Government, one egg in seven, on the average, is infected with harmful bacteria, which are only destroyed by very thorough cooking.

Within a few years an infectious disease due to a germ known as the *Bacillus pullorum* has spread rapidly over the country. This disease affects the ovaries of fowls, and eggs laid by infected hens contain the *Bacillus pullorum,* which when fed to rabbits in experimental work has produced the same disease in them. It is reasonable to suppose that human beings will also suffer from infection in like manner. The *B. pullorum* has been shown to be a cause of diarrhoea.

Although the Chinese eat with seeming impunity the "pidau," or ancient egg, which is known to be swarming with bacteria, there is no evidence that it is harmless. Eating decayed eggs may inoculate the intestine with bacteria that gradually break down the resistance of the intestinal mucous membrane and finally produce infection, besides flooding the body with toxins which the kidneys must eliminate to their certain detriment.

Doctor Rettger, who has investigated the subject, has found that eggs are often badly infected, showing a high bacterial count and much ammonia from putrefaction, notwithstanding the fact that they pass the candle test well and give no great evidence of decomposition. New and better standards for examination of eggs, milk and meat are urgently called for.

M. E. Pennington, of the U. S. Department of Agriculture, some years ago (1911), made a careful study of eggs, especially with reference to the presence of bacteria in eggs. Here are some of the facts discovered:

"The fresh, sound, shell egg is for practical purposes free from bacteria, though it is not always sterile. It is free from organisms of the colon group so far as we know. 'Stuck spots,' 'mold spots,' definite 'blood rings,' 'white rots,' eggs with a pronounced odor, 'grass eggs' (those having a greenish color in the egg white), 'musty eggs,' and 'sour eggs,' that is, eggs having a pungent quality which is difficult to describe but which is recognized by the trained sense of smell, are ordinarily possessed of a high bacterial content. 'Grass eggs,' 'musty eggs,' 'sour eggs,' and eggs having a pronounced odor cannot always be excluded by the candler. The others can and should be. The great majority of 'seconds,' 'heated eggs,' dirty shell eggs, and cracked eggs (not those from which the contents are escaping) show but few bacteria present when studied in the producing section. When cracked-shell eggs are kept, even for a few days, they frequently become infected with molds and bacteria. Cracked eggs, or 'checks,' as they are called in the trade, dirty shell eggs, and 'seconds,' which signifies a grade including undersized, soiled, 'checked,' and stale eggs, are commonly used by egg breakers. No 'spot' eggs of any sort are used by reputable breakers.

"Eggs in which the pungency of sourness is just beginning, eggs in which the faintest green of the 'grass egg,' can just be detected, and eggs that show a tendency for white and yolk to mix together but which are not, strictly speaking, 'rots' must be further investigated in order to fix the dividing lines between good and bad eggs more sharply and definitely. This study is now under way, and the investigation of all the kinds of individual eggs will be continued, since we cannot have too much information on the subject."

Pennington, to whose work we have above referred, and Kossowitz, of Vienna, have found that fresh eggs often contain molds, yeasts and various other micro-organisms. Pennington found only 12 per cent of the eggs examined entirely free from bacteria. Kossowitz found most eggs sterile when first laid, but discovered that infection readily occurs through penetration of the shell by various bacteria if the eggs by careless handling are exposed to contamination.

Candling of Eggs.

Eggs, even when known to be fresh, should be candled before using, as eggs are sometimes infected before they are laid and are also in other ways defective. The Bureau of Chemistry of the U. S. Department of Agriculture has prepared an egg chart which is shown herewith, together with an explanation of the same.

The popular notion that dark colored eggs are richer in fat than others is wholly without foundation.

Non-fertile eggs are generally considered of better flavor and are believed to keep better than fertile eggs.

Egg Poisoning.

Many persons are sensitized to eggs and cannot eat even a small fraction of an egg without suffering most unpleasant consequences. Nausea, vomiting, purging, headache, and a distressing nettle rash or urticaria are a few of the symptoms which result from the use of eggs by sensitized persons. Similar symptoms have been observed to follow the use of milk and of various other foodstuffs in different persons.

Lemoine, an eminent French authority, who has recently made a careful study of this subject, tells us that raw egg albumin and the lean flesh of animals in a raw state contain poisons which damage the kidneys. To the effects of this poison is due the appearance of albumin in the urine when raw eggs are eaten freely. These poisons are destroyed by the gastric juice as well as by cooking. The kidney poisons found in egg albumin when raw, are not destroyed by the gastric juice because of its slow action. These poisons are, however, completely destroyed by thorough cooking.

In a case recently observed by the writer, the symptoms of poisoning occurred only after the eating of the yolks of eggs, although in the majority of cases the unpleasant symptoms follow the use of the whites rather than the yolks.

Lemoine states that the effects of food poisoning may be avoided in many cases by taking a very small quantity of the objectionable food half an hour before the meal is eaten. It is also possible to overcome this special susceptibility by taking the objectionable substance in very small but gradually increasing doses. In the course of some weeks the amount may be gradually increased to the quantity usually taken at an ordinary serving. When the susceptibility is overcome in this way the effect, however, is often not permanent, the susceptibility returning after a time if the use of the particular article is discontinued.

When Eggs Should Not Be Eaten.

Claude Bernard observed that albumin appeared in the urine after the eating of a considerable quantity of white of egg. On this account many physicians forbid the use of egg by persons suffering with disease of the kidneys. Recent investigations lead to the conclusion that the healthy kidney never permits the passage of albumin and that when albumin appears in the urine it is evidence that the kidneys have been damaged. Persons suffering from Bright's disease, or who have albumin in the urine, should avoid the use of eggs, or at least should use eggs very sparingly, eating the yolks only.

Persons who are subject to so-called bilious attacks, sick headaches, or who have bad breath or other marked symptoms of autointoxication, would do well to avoid the use of eggs because they encourage the development of putrefactive flora in the colon. This is especially true of the white of egg. Egg white, when raw, leaves the stomach quickly but is not well digested, and soon finds its way to the colon, where it readily undergoes putrefaction. When boiled, egg white is digestible, but digests slowly when hard boiled, and when not well masticated, as is generally the case, is likely to reach the colon and there undergo putrefactive changes. The yolk of egg is readily digestible, even when hard boiled, and so is greatly to be preferred to the whole egg in cases in which it is desirable to restrict putrefaction as much as possible; but even yolks should be eaten sparingly. There is rarely ever real necessity for the use of eggs, for protein of equal, if not superior quality, may be obtained from milk, the soy bean, and from nuts, including the humble peanut.

Cholesterol, a resinous substance of which gallstones are formed, is normally present in the blood in the proportion of one part in two thousand parts of blood. The blood of a person of ordinary size contains about 20 grains of cholesterol. Laroche has shown that in persons suffering from gallstones the amount of cholesterol in the blood is considerably increased. A single egg contains about 4 grains of cholesterol. A couple of eggs would thus increase the amount of cholesterol in the blood to the extent of 40 per cent. From these facts it appears that persons who have undergone operations for the removal of gallstones, or are believed to be suffering from this disease, should carefully avoid the use of eggs.

MILK

Milk is a special food product prepared for their young by mammals or warm blooded animals. The milk-forming glands, which with rare exceptions are developed only in the females of mammals, are ordinarily active only subsequent to the giving birth to offspring. Occasionally, however, the mammary glands become active in females that have never given birth to young, and in rare instances the milk glands have shown a certain degree of activity in males.

Milk is nearly a perfect food, containing not only protein and fat as do other animal foods, but also carbohydrates, besides salts and vitamins. It is deficient only in iron.

TABLE XXXIX.

Showing the Composition of Cow's Milk and Milk Products.[*]

	Water	Proteins	Fats	Sugar	Salts	Lactic Acid
Cheese	36.8	33.5	24.3	---	5.4	---
Milk	86.8	4.0	3.7	4.8	0.7	---
Skim Milk	88.0	4.0	1.8	5.4	0.8	---
Buttermilk	90.6	3.8	1.2	3.3	0.6	0.3
Cream	66.0	2.7	26.7	2.8	1.8	---
Cottage Cheese	72.0	20.9	1.0	4.3	1.8	----
Butter	6.0	0.3	91.0	---	2.7	---
Whey	93.6	.8	.24	4.65	.65	---

Cow's milk contains about one-eighth its weight of solids, of which approximately one-third, or four per cent, is fat, four per cent casein and other proteins and four and one-half per cent lactose or milk sugar. To these are added .6 per cent of lime and other salts. The milk of each species of animals is exactly adapted to the use of the young of the species. In the milk of rapidly growing animals, the amount of protein and salts is much greater than in that of animals that grow slowly.

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[*] Compiled from various sources.

The milk of the cow enjoys in this country almost exclusive favor, but is by no means the universal lacteal food. Milk of various animals is used in different countries. Among the ancient Egyptians the milk of dogs was employed as well as that of the cow. In various parts of Europe the milk of the goat and the ewe is used quite extensively, and to some extent also, the milk of the ass. The milk of the camel is used in Arabia and Persia, of mares in Tartary, of the buffalo in Africa and China, of the yak in Tibet, of the reindeer in Lapland, and the llama and vicuna in South America.

The amount of milk produced in the United States yearly is about 87 billion pounds, representing 11,250,000,000 pounds of dry food substance which is produced by 24,000,000 dairy cattle, each of which requires daily 17 pounds of digestible food to produce 456 pounds (equivalent to 1800 quarts) of milk yearly, 13 pounds of dry digestible foodstuff for each pound of dry milk. To support these dairy cattle requires the product of not less than 48,000,000 acres of land. There can be no doubt that as meat production diminishes, as it is certain to do, milk production will likewise decrease. There is even at the present time a notable shortage of dairy products and the average per capita production will undoubtedly continue to decrease from the same causes which inevitably lead to a lessened meat production. Some other source of the complete protein needed to supplement the incomplete proteins of cereals and roots must be provided. Fortunately, Nature has supplied us with this all-essential foodstuff in nuts. This is a vitally important fact which sometime will save the race from protein starvation.

If, in the case of adults, it needs to be supplemented by other foodstuffs, cow's milk is for the young infant, when properly modified, a nearly perfect food. It contains in excellent proportions, all the elements needed by the growing child. This is not true of any other substance known.

The fuel element is represented in milk by fat and sugar of milk. The fat is of a sort easily utilized by the body.

Why Milk Sours While Meat Putrefies.

The sugar of milk is a special product well adapted to the needs of the body, far superior to cane sugar and free from the unwholesome properties of the products of the sugar cane. It is found nowhere else in Nature except in the milk of animals. Milk sugar is slowly digested and is absorbed only one-fourth as rapidly as malt sugar. This enables it more easily to reach the lower intestine where it is converted into lactic acid and so prevents the putrefaction to which modern science has traced a great number of the maladies of both infants and adults.

It is due to the presence of lactose that milk sours while meat putrefies. A dozen years ago (1908), I placed in a jar of buttermilk a raw beefsteak with no antiseptic of any sort. The beefsteak is still intact, thanks to the antiputrefactive properties of milk sugar and the acid-forming bacteria it feeds. One reason for this antiputrefactive property of milk is that in the presence of sugar even highly active putrefactive organisms produce harmless acids instead of noxious toxins and ptomaines. This is a most beneficent provision of Nature whereby the normal food of the young infant is kept in a wholesome state while undergoing digestion and absorption in the intestine.

The Special Value of Milk Proteins.

Milk is of special value in the dietary of human beings because of the fact that its protein is of very superior value. It is not only complete, but is capable of supplying all the elements required for building or repairing the living structures of the body, but is so rich in certain essential elements that it is able to make good the deficiencies in cereals and vegetables. In other words, the proteins of milk may be regarded as super-complete. Experiments have shown (Caspari) that milk protein is superior to meat protein.

It is evident, then, that milk is a foodstuff of high value, since it not only makes available to their fullest value, the enormous stores of protein found in wheat, oats and other cereals, but is also able to completely replace flesh-foods and even eggs in the dietary (Sherman).

McCollum considers milk of greater importance than meat in the national bill of fare and attributes to milk rather than to meat the physical superiority of certain meat-eating nations. This writer calls especial attention to the fact that meat-eating nations are also milk-eating. In view of this highly interesting result of recent scientific inquiry it is evident that the dairy interests of the country should be encouraged rather than beef and pork production.

In the use of milk it is important to remember that milk is a perfect food only for young animals of the particular species by which it is produced; that is, cow's milk is exactly adapted to calves, goat's milk to kids, sheep's milk to lambs, and human milk to human infants. The milk of most lower animals differs very widely from human milk in various important particulars, especially in containing a much larger amount of protein and a smaller amount of sugar. It is a curious fact that the milk of the mare and the ass approaches very closely in composition to that of woman, having approximately the same amount of protein, sugar and of salts. The milk of mares and asses is, however, deficient in fat, containing only one-third as much as does woman's milk.

It is important to remember that milk is notably deficient in iron. The milk of woman contains only a trace of iron for the reason that in human infants, as well as in the young of all animals that have a comparatively long nursing period, iron is before birth stored up in large amount in the liver, the liver of the new-born child containing iron enough to furnish an adequate supply for blood-making until the appearance of teeth enable it to make use of iron-containing foods. The same is true of the calf. It is to be noted, however, that in the case of the calf, the possession of teeth enables the young animal to begin securing supplies of iron from other sources than its maternal food within a few days after its birth. On this account cow's milk contains but a very small proportion of iron, only about half as much as is contained in woman's milk. For this reason it is highly important that bottle-fed children should be given iron-containing foods at an early period so as to prevent the anemia certain to result if the intake of iron is insufficient to supply the needs of the body for blood-making purposes after the liver's store has been exhausted.

Schlossman and Moro have shown that the proteins of human milk and of blood are identical biologically. Says McCollum,

"We could entirely dispense with meats without suffering any ill effects whatever, but if we permit the use of milk, even in the diet of adults, to fall much below the present consumption, its effects will soon become apparent in our national efficiency."

Milk Rich in Vitamins.

Another notable quality of milk is its richness in vitamins. These remarkable and magic working substances are, according to Funk, the discoverer, produced only by vegetables. Each plant produces its own sort of vitamins. The vitamins of milk are not produced by the cow, but are only collected by her.

It should be mentioned, however, that the full value of milk is possessed only by clean milk as it flows from the cow, and not by milk which has been boiled or pasteurized, or doped with alkaline or antiseptics, which destroy the vitamins and deprive the milk of one of its most unique and valuable properties.

Influence of Food of Cow Upon Milk.

Every farmer knows that both the quality and the quantity of milk produced are influenced by the food of the cow. Scientific research and practical experience have developed in recent years the science of animal feeding to a high state of perfection. The up-to-date farmer knows just what and how much to feed to produce the most milk containing the highest percentage of butter fat. Richness in fat, is not, however, the quality of greatest importance. Of far greater significance is the vitamin content of the milk. Recent investigations have shown that cow's milk varies greatly in the amount of this most essential food constituent. Cows fed upon fresh grass or other fresh green food produce milk rich in vitamins, while the milk of cows fed on dry hay instead is deficient. Since milk is often the exclusive food of young infants for several months during the most critical development period of their lives, this becomes a matter of greatest importance. Infants fed on milk from hay fed cattle do not grow at the proper rate and may be dwarfed and weakened for life, not only in stature but in other vital respects, even in the development of important internal structures.

Milk inspection should not stop with sanitary conditions and the health of the cow, but should include inspection of the cow's food supplies with reference to the infant's needs. All vitamins are produced by vegetables only; and if green stuffs are lacking in the food of the cow, they will be lacking in the milk, and the milk fed infant will suffer.

The feeding of sprouted grains to cows is an excellent means of increasing the vitamin content of their milk. Bottle-fed babies always require orange or tomato juice to insure an ample supply of vitamin, even when fresh, unpasteurized milk is used.

Milk Rich in Salts.

Cow's milk is also rich in salts, containing four times as much of these mineral elements as does mother's milk. Milk is particularly rich in lime. A pint of milk contains 11 to 16 grains of lime, more than is found in a pint of lime water. Note the contrast in this regard between milk and beefsteak, or flesh food of any sort. Meat supplies only half a grain of lime to the pound, although containing twice as large an amount of solids as does milk. The reason for this is obvious. Milk is a substance provided by nature as an exclusive food for a growing animal, and so must furnish lime for the bones as well as protein for the muscles. Meat represents but a fraction of the original foodstuff. When corn or other food is eaten by an ox, the several elements are separated, each going to form its own tissues—fat to fat, muscle to muscle, and lime to the bones. So to get back the whole assortment of food principles fed to an animal, one must eat its entire body, the whole ox, or the whole hog, bones and all. This being impossible, kind Nature has supplied us in milk with bones, muscles, brains, nerves, every bodily structure in solution, and in attractive form. Milk, in other words, is liquid flesh and bones with the tissue wastes, putrefaction products, parasites and other objectionable features left out.

Dried Milk.

Milk powder, or dessicated milk, consists of either whole milk or skimmed milk which has been reduced to a powder by removal of the water content by either one of several processes. The best process devised up to the present time consists in forcing the milk, in the form of a fine spray, into a heated vacuum chamber. The water contained in the minute droplets of milk is at once vaporized, leaving the solids to fall to the bottom in the form of a fine powder. The addition of water to powdered milk in the proportion of one part of milk to 7 or 8 parts of water restores the milk to a condition almost identical with that of fresh milk.

Dried milk possesses all the nutritive properties of fresh milk except that it is deficient in the scurvy-preventing vitamin, and so should be supplemented by orange or tomato juice.

The experiments of Chick and others have shown that the value of the antiscorbutic vitamin of milk is reduced at least one-half by drying, twice as much dried milk as raw milk being required to prevent scurvy in guinea pigs and monkeys.

Cream.

Cream consists of the fat of the milk with a certain proportion of casein and a small amount of salts and milk sugar. In cases in which protein is not well digested, cream diluted with water may be used in place of milk.

Cream is milk fat in a state of fine emulsion. On this account it is more easily digestible than is butter. It is rich in the fat soluble vitamin and should be more largely used as a source of fat. In the form of ice cream it is often used to excess.

Cream is more easily digestible than butter, because it presents the milk fats in the form of an emulsion. It is more easily digestible than oils or emulsified fats.

Butter.

Butter is the most important of all the animal fats. It is superior to vegetable fats in the fact that it is rich in vitamins which are derived from the milk. Vitamins are for the most part absent from vegetable fats. They are sparingly found in olive oil, cotton-seed oil, corn oil, peanut oil, and are absent in lard and found only to a small extent in other animal fats, with the exception of cod liver oil, owing to the fact that vitamins are stored in the animal body in the liver, kidneys and other glands. Cod liver oil contains vitamins, which fact at last explains the benefit long and widely attributed to this special oil in cases requiring improved nutrition. It is to be noted, however, that ordinary cream and butter possess all the advantages of cod liver oil in this particular besides being palatable instead of repulsive. When oleomargarine, nut margarine, vegetable oils or any other fat is used as a substitute for butter, free use should be made of milk to make certain that the body receives daily the due supply of vitamins, without which all the vital processes will languish and grave diseased conditions, which may even lead to death, are certain to follow.

Butter Color.

Good butter has a natural and decided yellow color. There is reason for believing that pale butter, which requires the use of annatto or some other coloring matter to give it the usual color, is lacking in vitamins, since Stenback and Bontwell have shown that the fat-soluble A vitamin, the absence of which gives rise to rickets, is often, if not always, associated with the yellow color found in yellow corn, carrots and green herbage.

The milk of cows contains more butter in the winter than in the summer, but winter butter is pale because winter food is largely lacking in the yellow pigments, carotin and xanthophyll, which abound in meadow grass in which these pigments are associated with chlorophyl.

Cheese.

Recently made cheese, particularly cream cheese and so-called cottage cheese, are wholesome foods. The so-called ripening of cheese in no way improves it, but rather, develops objectionable qualities. The ripening process is carried on by means of molds, yeast and bacteria which are present in the milk or added to it in the process of manufacture. Cheese cannot be made from sterilized milk without the addition of bacteria. Fresh cheese, particularly cottage cheese, is a valuable addition to the dietary as a source of lime. As a rule, the food contains a sufficient amount of protein without the addition of cheese, even in the absence of meat, but lime is very frequently deficient and may be conveniently added in the form of cottage cheese. Four ounces of cottage cheese will supply a day's ration of food lime.

Cream or cottage cheese, when freshly made, is more wholesome than meat and more nutritious. According to Williams, 20 pounds of cheese contains as much nutrient as the carcass of a sheep weighing 60 pounds. Cheese contains both more fat and more protein than beef and less than half as much water. The energy value of an ounce of cheese averages about 135 calories, while that found in an ounce of porterhouse steak is 70. Even cottage cheese made from skimmed milk has more than half the food value of a round or sirloin steak of the same weight. Cheese is also rich in all the essential vitamins, which are lacking in meat, and contains a rich store of food lime which is almost altogether absent in meat. The dietary of the average American will be greatly improved by discarding meats and substituting cottage cheese or cream cheese.

Skimmed Milk.

Milk which has been skimmed, especially separated milk, has been deprived of one of its most precious constituents, a highly valuable fat. Butter fat as present in milk is in a state of fine emulsion, a condition which greatly aids its digestion and assimilation, and contains a very precious vitamin, the so-called fat-soluble A, or antirachitic (anti-rickets) vitamin.

The suggestion of some writers that skimmed milk may be used in place of full milk as a measure of economy, provided that margarine or some other fat replaces the fat removed, is bad advice. Skimmed milk has a considerable nutritive value, but it lacks the growth-promoting power of full, fresh milk, and on this account cannot wholly take its place. When skimmed milk is used, it should not be used as a substitute for full milk but as an addition to the regular daily supply of full milk which every child should have. It may also be used as an added source of lime salts. It may be employed in cooking as in the preparation of bread, puddings, etc.

Skimmed milk may be used without detriment in connection with a liberal supply of butter. Used in this way, the skimmed milk now thrown away or fed to pigs would be worth more to the country if fed to human beings than all the meat produced by the live stock industry.

Canned Milk.

Sekina, in experiments on white mice, found that canned milk in time gave rise to anemia and beri beri. The mice did well for 100 days, then rapidly failed. The addition of iron and the water-soluble vitamin quickly restored them to the normal condition. Canned milk and condensed milk are thus shown to be unsuited to serve as staple foods for infants because of the lack of iron and the water-soluble B.

Canned milk may be advantageously used in connection with other foodstuffs as a source of complete protein, but should never be used as the chief food for any length of time unless supplemented by orange or tomato juice to supply vitamins and purée of spinach to furnish food iron.

TABLE XL.

Average Composition of Condensed Milks (Mohan).

	Solids %	Ash %	Fat %	Pro. %	Lactose %	Cane sugar %
Condensed whole milk	72.6	1.6	10.0	8.0	12.0	41.0
Condensed skim milk	70.0	2.0	1.0	10.5	14.5	42._
Evaporated milk	26.3	1.6	7.9	7.7	9.1	---
Whole milk powder	96.3	5.6	26.8	32.0	31.9	---
Skim milk powder	91.7	6.9	1.7	33.8	49.3	---

Cane sugar is usually added to the amount of 16-19 pounds to 100 pounds of raw milk. The condensing is done by heating for about 2 hrs. at 140° F. Condensed milk contains too much cane sugar to be suited for use as an infant food.

Buttermilk.

Buttermilk and sour milk have essentially the same composition. The sour flavor is produced by harmless lactic acid-forming bacteria. Buttermilk contains essentially everything which whole milk contains except the fat, which is reduced to about one-fourth of the ordinary amount. Buttermilk is more easily digestible than sweet milk. The acid-forming bacteria found in ordinay sour milk are of no particular value in changing the intestinal flora for they are unable to live and grow in the intestine. When buttermilk is desired for correcting biliousness or changing the intestinal flora, it should be prepared with the *B. acidophilus.* A quart, or better, three pints of acidophilus buttermilk taken daily for a week or two will usually produce a marked change in the character of the stools, causing the disappearance of the putrid odors through the suppression of putrefactive processes in the intestine.

Buttermilk ice cream is greatly to be recommended in place of ordinary ice cream. It contains but a small proportion of the fat found in ordinary ice cream and hence is much more easily digestible. Buttermilk ice cream is also practically free from any danger of tyrotoxicon poisoning which occasionally occurs from ice cream made in the usual way.

Whey.

The fluid residue left in the process of cheese making contains the milk sugar and much of the mineral matters of the milk, the casein or protein and fat having been removed. Whey is also rich in vitamins. It may be freely used to great advantage by persons who have long subsisted upon a dietary insufficient in lime. The composition of whey is as follows (Hutchinson):

Water	93.64 per cent.
Protein	.82 per cent.
Fat	.24 per cent.
Milk sugar	4.65 per cent.
Mineral matters, lime, etc.	.64 per cent.

The whey cure has long been practiced at various health resorts in Europe. The whey is not used alone, but in connection with other foodstuffs, particularly with a mixed diet from which flesh foods are largely excluded. The patient usually begins by taking a tumblerful of whey night and morning. The amount is increased from day to day until 10 tumblerfuls are taken daily. The whey is taken either warm or cold, plain or aerated. It is recommended by Gautley as a substitute for milk in feeding typhoid fever patients. The caloric value of whey is small, only 7 calories per ounce. By the addition of malt sugar or cereals, the food value of whey may be increased to any desirable extent. By adding 3 ounces of malt sugar to a pint of whey, the energy value is increased to 25 calories to the ounce, or 400 to the pint.

Modified Milk.

When employed in the artificial feeding of infants and in very many cases in the feeding of invalids, cow's milk must be modified. Ignorance of this fact and of the proper method of feeding milk is responsible for the death annually of a great multitude of artificially fed infants. Of the 2,500,000 infants born in the United States annually, not less than 250,000 die as the result chiefly of improper feeding. The mortality of bottle-fed infants is more than four times that of breast-fed infants. Cow's milk differs very decidedly from mother's milk. It contains four times as much lime and three times as much protein and only two-thirds as much sugar. Protein and fat are the elements of cow's milk which are the greatest source of trouble to the human infant. Each animal produces milk exactly adapted to its own young, calculated to promote the development of its digestive organs in a normal way. The milk of the whale and the seal contains 50 per cent of solids and an enormous proportion of fat which the young whale needs to protect it in the icy waters in which it lives. Cow's milk contains a large amount of protein and lime to support the rapid growth of the calf which attains puberty at the end of two years, about one-seventh of the time required for the human infant to reach the same stage of development.

Various formulas have been devised and recommended for the modification of cow's milk in artificial feeding. The most of these are more or less complicated. Recent experience has shown that a very simple method is much superior to the complicated measures which have been developed. It is only necessary to add two things, water and milk sugar or malt sugar, to render cow's milk suitable for the use of very young infants. A good formula is equal parts of full milk and boiled water with an ounce of malt sugar for each pint of water added to the milk.

The Iron Content of Milk.

The milk of all animals is notably deficient in iron. The milk of woman contains only a trace of iron for the reason that in human infants, as well as in the young of all animals that have a comparatively long nursing period, iron is before birth stored up in large amount in the liver. The liver of the new born child contains iron enough to furnish an adequate supply for blood-making until the appearance of teeth enable it to make use of iron-containing foods. The same is true of the calf. It is to be noted, however, that in the case of the calf, the possession of teeth enables the young animal to begin securing supplies of iron from other sources than its maternal food within a few days after its birth. On this account cow's milk contains but a very small proportion of iron, only about half as much as is contained in woman's milk.

Evidently, milk is a food naturally adapted to very young animals whose livers are able to supplement the iron of the food intake. An adult, fed upon milk exclusively, soon becomes anemic because of the exhaustion of his small reserve store of iron. It is not possible to obtain a full ration of iron from milk alone without taking a great excess of food. An ounce of milk contains less than half of one per cent of a day's ration of iron (.47 per cent), so that more than thirteen pints, or six and one-half quarts of milk are barely sufficient to furnish one day's iron supply. This represents a food intake of 4,400 calories, or nearly twice an ordinary day's ration. For this reason, milk feeding should always be accompanied by an abundant supply of greenstuffs and fruits rich in iron but with a small food value, such as spinach and other greens.

When man lived in his normal primitive state, subsisting upon his natural or biologic bill of fare, there was no occasion for the use of milk by adults. Everything he needed was supplied to him by the vegetable kingdom, as is still true respecting some primitive forest dwelling men; but in his present artificial, so-called civilized state, man has so far departed from his normal environment and has changed and denatured his food supply to such an extent that his diet has become deficient in many particulars and dangerously unbalanced. This situation has created a pressing need for certain things which are found in milk in rich abundance, especially lime, complete protein, and growth stimulating vitamins. Hence, notwithstanding its deficiency in iron, cow's milk and dairy products are highly important articles of food and render invaluable service in balancing the bill of fare by contributing essential salts and vitamins which the cow collects from the wild grasses of the pasture and other foodstuffs rich in lime and vitamins.

Fresh cream cheese and cottage cheese contain nearly four times as much iron as does milk, and thus make, when freely used, a distinct contribution to the iron intake.

The Lime Content of Milk and Cheese.

This group of foodstuffs is of unrivaled value as a source of food lime. All dairy products with the exception of butter are very rich in salts of lime. Pure fat is, of course, free from lime, which is chiefly associated with the protein or casein of the milk. But butter is not pure fat. It retains a portion of the buttermilk and so has a small lime content which is however, too insignificant to deserve consideration in the planning of a balanced bill of fare.

Milk, in some form, is one of the most convenient and reliable of all sources of food lime. Whole milk contains three-quarters of a grain of lime to the ounce. This is only half the amount found in almonds and filberts; but while these nuts can be utilized only to the extent of a few ounces daily, the milk intake may be raised to several quarts.

A pint of milk contains 12 grains of food lime of finest quality and 20 ounces of whole milk will supply a whole day's ration of food lime. Skimmed milk is a little richer in lime than whole milk, a fact which in itself condemns the very common waste of skimmed milk in connection with creameries. Considering the great lack of lime in the national dietary it is a serious question whether the feeding of skimmed milk to domestic animals should not be discontinued. The 87 billion pounds of milk produced annually in this country contain lime enough to supply 200,000,000 persons if all utilized.

We are rapidly becoming a toothless nation because of the lack of lime in our national bill of fare. This deficiency may be easily made up by the proper utilization of our dairy products and a suitable selection of foodstuffs. Cattle and hogs can easily obtain their lime from grass and other foodstuffs, to the utilization of which their digestive organs are specially adapted, so that they can consume the large bulk necessary.

In the use of milk, man adapts to his own use the choice lime salts which the mother cow has laboriously garnered from the fields and meadows and prepared in concentrated form for the feeding of her calf. Associated with the lime in whole milk is found also a choice collection of vitamins which promote growth, so that milk not only furnishes the material needed for building and maintaining the body frame work, but supplies an activating hormone which insures the proper utilization of the building material at hand.

It is interesting to note that a tablespoonful of milk supplies nearly the same amount of lime as an egg yolk, while a little more than half a pint of skimmed milk (9 ounces) supplies as much lime or bone building material, as a dozen eggs.

While skimmed milk contains more lime than whole milk the vitamin content is much less, a large portion being held in solution by the butter fat which has been removed. But the chief values of milk are left after the fat has been removed, and the great economic waste and physiologic damage which have resulted from the past failure to utilize this by-product of our great dairy industry, should be stopped as speedily as possible.

Buttermilk has a lime value almost equal to that of whole and skimmed milk, a pint and a half affording a full day's supply of lime. Sour milk commonly sold as buttermilk and under various trade names, is fermented or soured skimmed milk and hence has the same lime content as skimmed milk.

Cream is not by any means the equivalent of milk as a source of lime. An ounce of cream contains only two-thirds as much lime as the same quantity of whole milk. Nearly a quart of cream is necessary to supply a day's ration of lime on account of the larger amount of fat present.

But it is in cottage cheese that we find the richest and readiest means of increasing our lime intake. The solids of milk constitute one-eighth of its bulk and weight. Consequently, the elimination of the greater part of the water in the process of cheese making results in a great concentration of the lime content. Ordinary cheese has a lime content of 5.7 grains per ounce, or eight times the amount in whole milk, more than any other foodstuff. An ounce of average cheese supplies as much lime as seven yolks or five entire eggs, or 5 pounds of beefsteak, or half a peck of potatoes.

Old cheese is not easily digested by many persons. The butyric acid which it contains in considerable amount when old and strong, excites the gastric glands to secrete an excess of hydrochloric acid, and so gives rise to heart burn, a common symptom following the free eating of cheese. There are in old cheese various more or less toxic products the result of the activities of the numerous molds, yeasts and germs which co-operate in the production of cheese, to say nothing of the "mites" "skippers" (maggots) and other scavengers which are usually found in "ripe" specimens of cheese.

In view of these discouraging facts, it is pleasant to find that in the simple cottage cheese which the farmer's wife prepares on short notice in her own kitchen from the well skimmed sour milk of her "milk house," possesses all the good qualities of ordinary cheese while free from all its objectionable features. The only inconvenience is that it must be freshly prepared unless kept in an ice box. Cottage cheese supplies 4.2 grains of lime per ounce, and hence three and three-fourths ounces of cheese will furnish a day's lime ration.

"Yogurt Cheese,' a cream cheese prepared by a process modified by the writer from that employed in making the famous Cammembert cheese, omitting the green mold and using pure cultures of the *bacillus acidophilus*, has all the advantages of cottage cheese and will keep for months with some care to keep cool. This dairy product is a complete and satisfactory substitute for ordinary cheese for all but those who have developed a connoisseur's appetite for the putrescent aromas of limburger and gorganzola.

Even whey, a by-product of cheese making which usually goes down the sewer, possesses no mean value as a source of nutritive lime salts. There are in the whole category of foodstuffs few, in fact, which are so rich in lime as is whey, which contains more than ¼ grain to the ounce. The lime content of whey is greater than that of any cereal, three times as great as that of egg whites, and four times as much as that of cornmeal, or rice. A large glassful of whey contains as much food lime as a large serving of rice. The same amount of whey contains as much lime as two pounds of beefsteak and a pint is equal in lime content to two-thirds of a dozen eggs. Three pints a day, taken as a beverage in place of beer, for example, would supply nearly a days lime ration, as much as would be furnished by a fifty gallon cask of beer.

Milk Must Be Clean.

The chief reason assigned for the pasteurizing or sterilizing of milk is the presence in the milk of large or small quantities of filth which should have been left in the stable or the barnyard. Combe and others have shown that the germs associated with this putrefying filth are the most prolific source of diarrheas, and other intestinal disorders which annually carry off so many thousands of infants during the summer months. These same putrefactive germs are likewise the cause of intestinal toxemia or autointoxication.

As received from the cow, milk may or may not contain bacteria. In general, the milk of a healthy cow, if removed from the animal with sufficient care, will be found to be absolutely free from bacteria, and if put in a proper container will keep without spoiling for an indefinite period. Certified milk must contain less than ten thousand bacteria to the cubic centimeter (about one fourth of a small teaspoonful). Ordinary commercial milk contains from one hundred thousand to several million bacteria to the cubic centimeter and is absolutely unfit for use. The number of bacteria found in milk rapidly increases. For example, in a specimen of milk 24 hours after milking, the number of bacteria had increased from 100,000 to 5,600,000.

Sour Milk.

The souring of milk is due to the development of lactic acid through the growth of acid forming bacteria. There are many varieties of acid-forming bacteria which readily find access to milk, and as they grow rapidly at ordinary temperatures, milk will naturally sour within a few hours after milking unless the temperature of the milk is at once lowered to a point at which the growth of the bacteria is prevented.

The *B. acidophilus* is a special acid-forming organism which not only grows and thrives in milk but is also able to live in the colon of animals. This is known to be true of the *B. acidophilus*, which is by some thought to be a variety of the *B. bulgaricus*. It is for this reason that buttermilk prepared with the *B. acidophilus*, is to be preferred to ordinary buttermilk since ordinary buttermilk or sour milk germs will not grow in the colon, and hence are of no value in combating putrefaction.

Bitter Milk.

The bitterness of milk may be due to the fact that the cow has eaten substances having a bitter flavor. A bitter flavor also results from changes in the milk produced by certain germs. Such milk should be rejected.

Slimy and Colored Milk.

Slimy or ropy milk owes its peculiarity to the growth of a special microorganisms which causes viscosity.

There are various germs which color the milk through the production of characteristic pigments.

Bacteria on Milk Bottles.

The city health department of Baltimore, Maryland, made a study of the bacteria deposited on the caps and rims of milk bottles. In the handling of milk bottles by milk distributors and their exposure to city dust in milk wagons and while waiting upon doorsteps to be taken in, germs of various sorts, some dangerous to life, are deposited in considerable numbers. Germs, even very dangerous germs, are sometimes conveyed to the lips of milk bottles by the hands of milkmen. Other germs, such as typhoid and dysentery germs, are deposited by flies. Contamination may occur through contact of animals with milk bottles. Cats and dogs often lick the mouths of milk bottles while standing on the doorstep.

The examinations made of numerous milk bottles showed various sorts of dangerous germs and indicated that there is a real risk in the use of milk from containers in themselves thoroughly clean and sanitary. The milk becomes contaminated by contact with the lip of the bottle when it is poured from the bottle. The cap and lip of the milk bottle should be very carefully wiped with a cloth dipped in boiling water or peroxide of hydrogen before the milk bottle is opened. The importance of doing this should be known to every housewife and should never be forgotten.

Infections Due to Unclean Milk.

Milk must be free from the germs of disease. In addition to the common organisms which give rise to putrefaction and with which the milk becomes contaminated through careless dairy methods, milk may contain germs of various specific diseases such as tuberculosis, typhoid fever, diphtheria, scarlet fever, sore throat, Malta fever,—maladies originally derived from human beings suffering from the above named disorders and with the germs of which the milk, by direct or indirect contact, becomes contaminated.

Milk may also communicate to human beings various disorders which originate in cattle, but which may be communicated to human beings by making use of the milk of sick animals, such as foot and mouth disease, milk sickness, gastroenteritis, anthrax, cowpox, rabies, actinomycosis and perhaps other maladies.

Infected Milk a Cause of Tuberculosis.

Modern research has shown that bovine tuberculosis is communicable to human beings. According to Rosenau, it must be conceded that not less than 5 to 7 per cent of all cases of human tuberculosis are due to infection from the use of infected milk or the flesh of tuberculous animals.

A careful examination of the mortality tables published by the United States Census Bureau shows that not less than 3,000 children die annually as the result of infection with bovine tuberculosis, and not less than 60,000 children are constantly suffering from bovine tuberculosis contracted chiefly through the use of diseased milk.

The New Jersey Tuberculosis Commission found 16 per cent of the dairy cattle in that state suffering from tuberculosis. In some parts of Germany 30 per cent of all cattle were found to be infected with this disease. An investigation made of the milk supply of the District of Columbia showed that 15 to 25 per cent of all the cows furnishing milk to that community were infected.

Tubercle germs are not readily killed by dairying processes. Schroder killed guinea pigs by infection with germs found alive in butter five months after it was churned. Tubercle germs have been found in great numbers in cheese and ice cream. Morgenroth even found tubercle germs in 9 out of 28 samples of oleomargarine purchased in the open market.

Injurious Effects of the Sterilizing or Pasteurizing of Milk.

The public has been taught to place too much faith in sterilized or boiled milk. It is true that pasteurization or boiling of milk destroys certain specific disease-producing organisms such as those of typhoid fever, tuberculosis and diphtheria, but these processes at the same time destroy certain highly essential, vital properties of milk, and as has been long known, fail to destroy the spores of putrefactive organisms, which probably are, on the whole, the cause of far greater mischief and many more deaths than the organisms which give rise to tuberculosis, typhoid fever and other specific organisms. If left to itself, raw milk does not decay but sours. Boiled milk rots. The acid-forming organisms which find their way into the milk from the air thus exercise a protective influence, preventing the toxemia which results from intestinal putrefactions. When an infant is fed upon sterilized milk, the stools, which are naturally slightly acid, quickly become foul smelling through putrefaction and the infant is thus exposed to highly potent disease-producing influences against which it is protected when fed upon natural, clean milk. A temperature of 240 degrees for half an hour is required to destroy the spores of putrefactive germs and even such milk is likely to promote putrefactive processes in the intestine, especially in the case of young children. It is thus apparent that pasteurization and boiling of milk should be regarded only as makeshifts which mitigate to some degree the evils resulting from the use of milk contaminated with barnyard filth but are not by any means a substitute for clean natural milk. The movement to provide "certified" milk should be everywhere encouraged.

Whenever pasteurized or sterilized milk is used, free use should be made daily of orange juice, tomato juice, potato soup or some other foodstuff rich in vitamins.

The boiling of milk modifies in a harmful way nearly all its ingredients and considerably reduces its nutritive value. Rats fed on boiled milk grow to only half their normal size.

Scurvy sooner or later appears in babies exclusively fed on pasteurized or boiled milk. The subtle alchemy by which milk is prepared in the laboratory of Nature is upset by the crude process of cooking. Boiled milk will sustain the life of rats but it will not enable them to grow to full development, and reproduction fails altogether. Science is teaching us every day that the fine adjustments and adaptations of nature cannot be safely ignored. We are gradually learning through the loss of millions of lives which have perished through our ignorance, that the foodstuffs which nature designed for our use are not the haphazard products of wild and incoherent forces but are wrought out by a subtle and infinite wisdom which fits them to our needs so perfectly as to transcend our highest knowledge and defy the profoundest analysis.

Another defect of the pasteurizing process is found in the fact that it is not absolutely certain. Cases of tuberculosis have occurred in calves fed on the pasteurized milk of tuberculous cows.

Another matter of much significance which must be borne in mind in relation to pasteurized milk is the rather surprising fact that, if not handled with very great care, pasteurized milk is likely to develop within a short time more bacteria of a dangerous type than are found in ordinary raw milk. The reason for this is that most of the bacteria found in ordinary raw milk are of the acid-forming sort; that is, they are of the kind commonly known as buttermilk or sour milk germs, so-called friendly or protective germs. So long as these bacteria are dominant, the growth of putrefactive organisms is prevented.

Boiling, if thoroughly done, may destroy the germs of typhoid, tuberculosis, and other infectious diseases. It does not however, destroy the spores of the germs which produce putrefaction and consequently, if boiled milk is allowed to stand for a few days these undestroyed spores develop and putrefactive changes take place.

It should be noted, also, that in the boiling of milk the germs which produce souring are destroyed. Consequently, boiled milk is less likely to sour than unboiled, but instead may undergo putrefactive changes, and the same thing that happens in the laboratory test tube or the milk bottle may happen in the intestine; that is, boiled milk is more likely to undergo putrefaction in the intestine than is raw milk.

Among the numerous dangerous organisms derived from stable filth and found in unclean milk is the highly virulent Welch's bacillus, the cause of gas gangrene. Estey found this germ present in all but two of a large number of samples of market milk obtained in Providence, R. I. It is often present in commercial milk.

It is evident that pasteurization does not solve the milk problem. When scientifically done, pasteurization does mitigate some of the evils associated with unclean milk but the only true solution for the problem is clean milk.

It is also known that boiled milk is less easily digestible than raw milk. Hence it is important to emphasize the fact that milk should be produced in such a way as to be in the highest degree possible free from bacteria and other impurities of every sort. In an experiment in feeding of calves with boiled milk between 80 and 90 per cent of the calves died, and there can be no doubt that thousands of human infants have lost their lives from the same cause.

Buddized Milk.

Milk may be sterilized sufficiently to keep it sweet for several weeks at ordinary room temperature by means of peroxide of hydrogen, a harmless germicide which is decomposed into oxygen and water. A teaspoonful of fresh peroxide to a pint of milk is sufficient to keep the milk sweet for a week in a cool place. After adding the peroxide the milk should be kept stirring and at a temperature of 130° F. for half an hour. It is claimed that this process destroys all harmful bacteria. Buddized milk has been used for years in the babies' ward of a large Chicago hospital and is much used by makers of ice cream throughout the country.

Certain observers claim that peroxide of hydrogen destroys the antiscorbutic vitamin. This being true, it is evidently necessary that if this method is employed, orange juice, tomato juice, turnip juice, or some other antiscorbutic should be used in adequate quantity.

Certified Milk.

Certified milk is milk produced under special conditions which are calculated to insure freedom from disease and germs. The following are the requirements as laid down by the American Association of Medical Milk Commissions:

"(a) Certified milk shall be produced by a trustworthy dairyman in accordance with a code of requirements prescribed by a medical milk commission. The dairyman shall enter into a legal contract with the commission, in which he shall agree to comply with all its requirements.

"(b) Certified milk shall be obtained from healthy, tuberculin tested cows under veterinary inspection; all persons who directly or indirectly come in contact with the milk shall be under medical supervision and the milk itself shall be subjected periodically to bacteriological, chemical and other tests.

"(c) Certified milk should be free from harmful germs and shall contain relatively few of the common bacteria. It should not contain more than 10,000 bacteria per cubic centimeter; this average should be based upon bacteriological examinations covering a period of ninety days, and the counts should be made at least once a week during this time.

"(d) Certified milk must be bottled at the point of production, rapidly chilled, kept cold and delivered promptly to the consumer. After it is once chilled, the temperature of certified milk should at no time go above 45° F., or below 32° F.

"(e) Certified milk shall be normal milk; that is, neither heated, frozen nor altered in any way except strained and cooled.

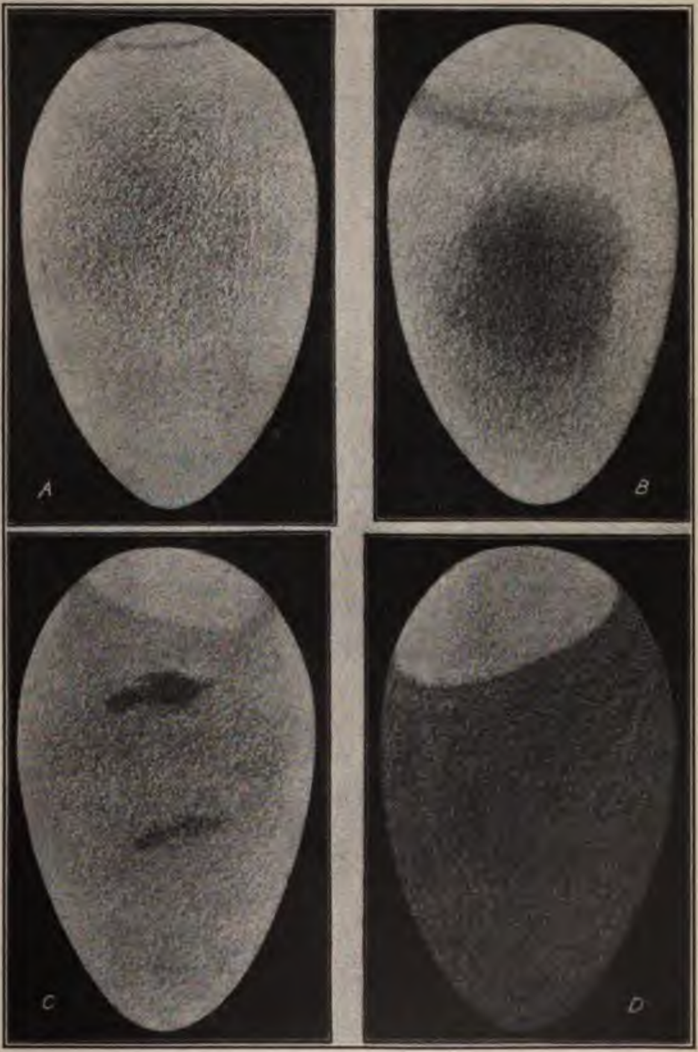
"(f) Certified milk shall be of uniform quality and contain not less than 3.8 per cent, nor more than 4.2 per cent, of fat, unless it is labeled otherwise, in which case it shall not vary more than 0.2 per cent from the amount stated on the label.

"(g) Certified milk shall not be subjected to the action of heat; shall not be subjected to the action of any preservative whatever except cold; shall not be subjected to the action of light, electricity, pressure, or any special force or agency of any kind for any purpose; no substance of any kind shall be added to the milk for any purpose; and no part of the milk shall be removed.

"Pastures or paddocks to which cows have access shall be:

"(a) Free from marsh or stagnant pools.

"(b) Crossed by no stream which might easily become dangerously contaminated.



APPEARANCE OF EGGS WHEN CANDLED

A Fresh Egg; B Stale Egg; C Egg Showing Fungous Spots; D Rotten Egg. (*Yearbook U. S. Dept. of Agric.*, 1911).

THE BATTLE CREEK SANITARIUM DAIRY BARN

Beefsteak Preserved in Buttermilk For 15 Years.

"(c) A sufficient distance from offensive conditions to suffer no bad effect from them.

"(d) Free from plants which affect the quality of the milk deleteriously."

It is highly desirable that associations for the production of certified milk should be formed in all parts of the United States so that safe milk may be provided, especially for children and invalids. As a matter of fact, the entire milk supply of the country ought to be produced under certified conditions. Milk is wholesome only when clean, and it is to the highest degree absurd to accept the ordinary commercial product as it reaches the average consumer at the present time. Water containing one-thousandth part as many germs as are usually found in milk would be at once condemned and unfit for use.

The accompanying cuts show the dairy of the Battle Creek Sanitarium which supplies milk which never contains so many as 10,000 bacteria per cubic centimeter, and usually contains less than 1,000.

A Person May Be Sensitized to Milk.

Another point to which attention should be called in the interest of both infants and invalids is the fact that certain persons become sensitized to milk as well as to other forms of protein, and to a person who is sensitized, even the smallest amount of milk may give rise to dangerous or even fatal symptoms. Many infants die annually from this cause. This fact should be borne in mind in changing the infant from the breast to bottle feeding. The milk should first be given in very small quantities, a teaspoonful in a half glass of water, the proportion being gradually increased until the proper dilution is reached. The same method should be pursued with individuals who have learned by experience that unpleasant symptoms are noted after the use of milk. The adult or infant who is sensitized to milk may be cured by the administration of milk in graduated proportions, beginning with extremely small doses. Such a case requires the personal care of a physician.

According to Weill, of Paris, the intolerance for milk shown by infants and many adults, may be overcome by the hypodermic injection of milk. The first dose should be very small, eight or ten drops. At the end of an hour, four times this dose may be administered, and three hours later, ten times the original dose. The milk should be sterilized by boiling 15 or 20 minutes.

Another method which has been employed with success is to take the milk in graduated doses, beginning with very small quantities, say a teaspoonful, or even half as much, diluted with water. In the course of a few weeks the amount may be increased to half a glassful or even a glassful at each meal. Another method is to take a small quantity of milk, say one or two teaspoonfuls, half an hour or an hour before a meal at which a larger quantity of milk is taken.

Medical Uses of Milk.

Milk is not only useful as a nutrient for healthy persons, but by proper management, may be made to play a highly important rôle as a curative agent. For example, there is no better means of inducing a rapid gain in flesh than by milk feeding. There are many other medical uses of milk in the form of the milk regimen. The free use of milk is especially useful to cure as well as to prevent lime starvation which, according to Professor Sherman of Columbia University, is coming to be almost universal in this country, and is doubtless largely responsible for the early decay of the teeth noted among American children.

How to Eat Milk.

Milk must be eaten, not swallowed as a beverage. It must be chewed. All foods need to be masticated. The calf and the nursing infant chew the milk which they draw from the maternal font. The movements of the jaws and the sucking movements executed by an infant in nursing induce an abundant flow of saliva which, mixing with the milk, properly dilutes it, and to a high degree promotes digestion. Milk when swallowed rapidly as a beverage is likely to form in the stomach large and hard curds which are very slowly digested. Many persons who suffer from taking milk in this way imagine themselves to be unable to take milk and so abandon its use. I remember a man to whom I had recommended the liberal use of milk. He protested that he was absolutely unable to use it at all and stated that on the last occasion on which he had taken milk he had nearly lost his life. A few hours after hastily swallowing several glasses of milk he experienced a sensation of suffocation, was then nauseated and on attempting to vomit experienced a choking sensation. On reaching his finger down his throat he felt a mass which he seized and to his astonishment drew out a rope of milk nearly a yard in length. The milk had formed in his stomach one large, hard curd which he was certainly very fortunate in being able to get rid of so easily. The famous English surgeon, Dr. Lawson Tait, told me of a case in which he was obliged to perform a surgical operation to remove a similar mass of curds which had lodged low down in the intestine.

Milk should be sipped slowly and with a sucking movement or taken through a straw so as to secure a liberal admixture of saliva. By this means the formation of hard, indigestible curds will be prevented.

Milk must be taken in right quantities and in right combinations. It cannot be denied that milk digests better when taken by itself or in very simple combinations than when mixed with a large variety of other foodstuffs. In some instances, also, a large quantity of milk is more easily digestible than a small quantity. When the stomach produces a large amount of highly acid gastric juice, as is usually the case with persons who have been accustomed to a hearty meat diet, the curds formed when a small amount of milk is taken will be large and tough, whereas if a larger amount of milk is taken, the curds formed will be smaller and softer. Hence, the proper remedy in many cases in which a person complains that he cannot take milk, is to take more milk.

As already remarked, the taking of milk with meat is perhaps the worst of all dietetic combinations. The reason for this was made clear by Pavlov, the eminent St. Petersburg physiologist, who showed that meat requires a highly acid gastric juice for its digestion and that the stomach produces this sort of juice when meat is eaten, while milk demands and calls forth a juice lower in acid.

When milk is largely used as a nutrient, the remainder of the diet should consist chiefly of fruits and vegetables for the reason that milk contains an excess of lime and is deficient in potash and soda which are necessary for perfect human nutrition. The last named elements are abundant in fruits and vegetables, particularly the potato, which is also very rich in salts of potash. A diet consisting exclusively of milk and cereals is less satisfactory. Such a diet often gives rise to scurvy in infants. Cereals are deficient in the alkaline elements which are needed to neutralize the acid products developed in the body.

In the use of milk, it is well to remember, also, especially when it is freely taken, that one may easily by this means ingest an excess of fats. The milk of certain breeds of dairy cattle is exceedingly rich in fat. The use of such milk in some persons, and especially in infants and young children, gives rise to symptoms which are sometimes denominated as biliousness, but which are not directly connected with the liver, being due to putrefactive changes set up in the intestine by the presence of an excess of fat. Breeders of dairy cattle have labored to produce strains of milch cows which produce milk containing a large amount of fat because they are more profitable, but for table use, milk containing only a moderate amount of fat is preferable.

Milk is very little used by the Chinese, who from the most remote times have had a prejudice against this article of food, believing that by using milk one would acquire the characteristics and qualities of the animals from which the milk was obtained, just as certain primitive tribes refuse to eat pigs, fearing that their eyes will become small like those of the pig. The Chinese have been able to dispense with milk because of the superior virtues of the soy bean from which they prepare an excellent milk and also a palatable cheese and because of the very large use of greens.

It must be recognized, however, that the greatest value of milk as a food for adults is to be found in its use as a supplementary or complementary food; that is, as a means of rendering biologically complete a dietary otherwise consisting exclusively of the products of the vegetable kingdom. A strict vegetarian diet is likely to be incomplete unless formulated with extraordinary care and scientific wisdom; but almost any group of vegetable foodstuffs which may be selected will prove satisfactory as nutrients if supplemented with a daily pint of good milk.

The Africans, unlike the natives of the far East, make large use of milk. This may be due to the fact that they have abundant pasturage whereas the Orient has long been, in many parts at least, over-populated.

According to Simmond, the Kaffir often subsists almost exclusively on a diet consisting of sour milk with the addition of a little millet. One meal a day of this food suffices to keep him in vigorous health.

Among the primitive tribes of Africa, according to Dr. Turner and Rev. Bryant, milk is practically always permitted to sour before using. The Zulus pour the milk when still warm from the cow, into a gourd kept for the purpose. Loosely stoppered, the gourd is placed in the sun. At the end of 48 hours the milk is clotted and the whey is drained off. The gourd is filled with fresh milk. The next morning the milk is ready for use. The whey is drained off and the curds shaken out. Once a week the gourd bottle is thoroughly washed and scalded. The "amasi" ("amafi" of the Kaffirs) thus prepared is closely akin to the yoghourt of the Bulgarians.

Milk a Cheap Food.

Even at its present high price (1921) which is very likely to be higher rather than much lower, milk is a comparatively cheap and economic food. A pint of milk is equal in food value (calories) to a pound of codfish, a half pound of lean beef or veal, a quart of oysters, three pints of beef juice, or three and a half quarts of bouillon.

Ten cents will buy in the form of milk more than twice as much food as in the form of beefsteak, ten times as much as in the form of oysters, three to six times as much as is supplied by ten cents worth of eggs. Milk is really by far the cheapest of our ordinary animal foods.

Milk, even at the price of certified milk, is a cheaper food than beefsteak. For example, a pound of steak at 40 cents supplies 450 to 650 calories, or 14 calories for one cent; while a quart of certified milk at 35 cents supplies 650 to 740 calories, or 20 calories for one cent, a difference of more than 40 per cent. in favor of the milk, to say nothing of the very great superiority in quality.

When we consider the amount of tissue building material which may be produced on a given area of land, the economy of milk as a foodstuff becomes still more apparent. According to Professor Henry, late Dean of the Agricultural Department of the University of Wisconsin, 100 pounds of digestible food, when fed to animals, produces the following quantities of actual foodstuff:

Milk	18.0 pounds
Eggs	5.6 pounds
Beef	2.8 pounds
Mutton	2.6 pounds

It is evident from the above that the cow is more than six times as efficient a food transformer as is the steer. Feeding corn to steers wastes ninety-seven per cent of the corn.

It is also evident that the dairy interests of the country ought to be encouraged rather than the production of beef, pork and mutton.

TABLE XLI.

Composition of the Milk of Various Animals.

The following table compiled by Voltz from various sources, shows the great differences in the composition of the milk of different animals:

Milk	Water	Solids	Fat	Casein	Total Protein	Sugar	Ash	Calories per oz.
Human	87.58	12.42	3.74	0.80	2.01	6.37	0.3	19
Cow	87.80	12.20	3.40	2.70	3.40	4.70	0.7	18
Buffalo	82.30	17.70	7.70	....	4.80	4.40	0.8	31
Zebu	86.13	13.87	4.80	....	3.03	5.34	0.7	22
Llama	86.55	13.45	3.15	3.00	3.90	5.60	0.8	19
Camel	87.60	12.40	5.38	2.98	....	3.26	0.7	17
Goat	86.30	13.70	4.00	3.60	4.60	4.30	0.8	20
Sheep	81.50	18.50	7.00	4.30	5.60	5.00	0.9	30
Reindeer	67.70	32.30	17.10	....	10.90	2.80	1.50	59
Mare	90.58	9.42	1.14	....	2.50	5.87	0.36	12
Donkey	90.12	9.88	1.37	0.79	1.85	5.19	0.47	12
Elephant	67.85	32.15	19.57	....	3.09	8.84	0.65	63
Hippopotamus	90.43	9.57	4.51	....	....	....	....	12
Rabbit	69.50	30.50	10.45	....	15.54	1.95	2.56	47
Guinea pig	41.11	58.89	45.80	....	11.19	1.33	0.57	131
Dog	77.00	23.00	9.26	4.15	9.72	3.11	0.91	38
Cat	81.64	18.36	3.33	3.11	9.53	4.91	0.59	25
Pig	82.37	17.63	6.44	....	6.09	4.04	0.59	28
Blue whale	50.47	39.53	20.00	....	12.42	5.63	1.48	72

Infant Foods.

Most infant foods consist of starch which has been fully or in part digested by means of malt or exposure to a dextrinizing temperature.

The following table shows the composition of various infant foods as determined by the chemists of the Connecticut Agricultural Experiment Station (Report for 1908).

According to the report above referred to most of these foods are prepared by very simple methods from ordinary foodstuffs.

Horlick's Malted Milk consists of a malt digested mixture of wheat flour and milk.

Fessenden's Food is made from arrowroot, wheat, rye, and barley malt.

Ridges' is simply "baked flour," consisting largely of raw starch.

Mellin's food consists of wheat flour which has been digested with barley malt.

Peptogenic Milk Powder is chiefly milk sugar.

Allenbury's milk food consists of a mixture of pasteurized milk and malted wheat.

Eskay's albumenized food consists of cereal flour combined with egg albumen.

TABLE XLII.

Composition of Certain Infant Foods.

	Water	Ash	Protein	Fibre	Carbo-hydrates	Fat	Lactose	Soluble in Water	Starch
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Milk and Cereals									
Allenbury's Milk Food No. 2	4.98	3.69	9.00	0.28	68.33	13.72	27.14	82.27	....
Horlick's Malted Milk	3.63	3.70	12.94	....	71.37	8.36	0.39	88.58	....
Lactated Food	7.12	1.19	8.13	.....	82.84	0.72	9.67	34.54	41.94
Malted Cereals									
Fessenden's Food	5.95	1.60	6.00	0.08	85.97	0.40	0.36	48.80	35.69
Mellin's Infant Food	5.07	3.79	10.50	0.25	79.24	1.15	0.37	83.97	....
Ridges' Food	9.24	0.60	11.81	0.05	77.26	1.04	0.12	3.90	69.46
Miscellaneous									
Peptogenic Milk Powder	3.02	1.40	0.81	....	94.67	0.10	90.53	95.40	....
Eskay's Albumenized Food	3.06	1.34	6.56	0.04	87.80	1.20	36.98	51.10	28.41
Malted Nuts (Atwater)	2.60	2.20	23.70	....	43.90	27.60	....	....	2.40

Condiments

Man is the only animal that deliberately commits suicide by self-poisoning. He is the only one that spoils his food before he eats it. The average man suffers constantly from chronic poisoning. He doses himself with poisons of various sorts which in the aggregate make a per capita dose of more than fifty grains of poison every twenty-four hours for every man, woman and child in the United States. He begins the day with a poison dose in the form of coffee to wake him up. After breakfast he smokes a cigar to settle his stomach and quiet his nerves. Before dinner he swallows half an ounce of whiskey or "bitters" to get an appetite. He finds an afternoon cup of tea necessary to cure after-dinner stupor, and at night needs an opiate to get to sleep, and in the morning a cathartic to move his bowels. With his other poisonings he deliberately spoils his food by putting into it toxic substances, the excretions of plants, which by means of acrid, biting and burning flavors are labeled by nature as belonging to the poison class and unfit to be eaten. These products which are used only for their flavoring properties, having no food value, are known as condiments.

There are two classes of condiments; first, those which contain irritating but non-volatile oils, like mustard, pepper, cayenne, capsicum, horse-radish, ginger, and spices; second, those which contain irritating volatile oils, like mint and thyme. To these may be added common salt, although this is by some regarded as a food.

Condiments of the first class stimulate the activity of the stomach, causing it to empty somewhat quicker but lessening the secretion of gastric acid. Condiments of the second class lessen the activity of the stomach and diminish secretion. It should be added at once, however, that condiments of the first class, although they at first increase the contractile activity of the stomach, later produce an opposite effect. Consequently, the effect of condiments is the opposite of what it is popularly supposed to be, depressing and hindering digestion rather than aiding it. The ultimate effect of artificial stimulation is always to depress and lessen function. The effect of such stimulants upon a weakened organ is precisely the same as that of a whip when applied to a tired horse. The forced action produced inevitably has the effect to still further lessen an already depleted store of energy and so hasten the time when complete failure will result.

Condiments of all sorts should be rigorously excluded from the table. The essential oils found in condiments are all irritant poisons. When applied to the skin in concentrated form, they produce irritation or blistering, inflammation, and even serious destruction of tissue if the contact is prolonged. The effect upon the stomach is similar.

Various condiments are the chief ingredient of the curries of the East, the effect of which in producing gastric catarrh and hemorrhoids with other forms of disease of the rectum has long been well known. A moment's thought will make clear how these irritative substances are particularly injurious to the terminal portion of the alimentary canal. When pepper, mustard, and similar substances enter the mouth they are very largely concealed by the food, but when the food has been digested and absorbed, the condiments, which are in large part left behind, are concentrated, and remaining some time in contact with the mucous membrane of the rectum, are quite capable of setting up a serious irritation similar to that which is produced by concentrated mixtures of condiments upon the skin and other sensitive parts.

Through absorption into the blood, the poisonous oils of condiments are brought into contact with every cell and fiber of the body. The first effect is produced upon the delicate walls of the blood vessels. A defensive effort causes these to become thickened, a change known as arteriosclerosis, because the primary thickening is followed by hardening through a deposit of chalk. The eminent Professor Huchard, of Paris, the world's greatest authority upon this subject, showed that mustard and other condiments, when administered to animals, may produce changes in the blood vessels within a few months' time.

The same poisonous effects produced upon the blood vessels are also produced in the kidneys, the delicate cells of which being brought in contact with the poisons in more concentrated form through their elimination by way of the urine, are made to undergo degenerative changes through which their efficiency is impaired and Bright's disease and other disorders produced.

Boix fed half a gram (7½ grains) of pepper to a rabbit daily. The animal died at the end of twenty-seven days. The liver was found sclerotic and its cells degenerated. The kidneys were greatly congested.

The Use of Condiments as Preservatives.

The preservative influence of the essential oils found in various condiments, particularly in cloves and cinnamon, has long been known. Recent experiments show that 2 to 5 per cent. of an alcoholic extract of cloves or cinnamon, or 4 per cent of scraped horseradish, will prevent the development of bacteria in tomato pulp. Mustard and anise seed have a similar effect. These preservatives have been much used in recent years as substitutes for benzoic acid, salicylic acid and other preservatives, the use of which has been excluded by the pure food laws. In the opinion of the writer there is no advantage in exchanging salicylic acid for oil of cloves or any other of the essential oils mentioned. As a matter of fact the salicylates are probably less harmful than these acrid oils. The use of these chemical preservatives is not necessary, and since all of them are alike harmful, their use in the manufacture of foods should be forbidden by law.

The Taste for Condiments Unnatural.

The taste for condiments is altogether an acquired one. Condiments of all sorts are highly repulsive to infants and to all persons whose tastes have not become vitiated. There is no place for these poisonous products in the biologic dietary.

That the taste for pickles, which has become quite generalized among civilized people, is an acquired and unnautral appetite, is well shown by the following story told by George Kennan in his delightful book, "Tent Life in Siberia":

"One evening, soon after we left Shestakova, they (Korak drivers) happened to see me eating a pickled cucumber; and as this was something which had never come within range of their limited gastronomical experience, they asked me for a piece to taste. Knowing well what the result would be, I gave the whole cucumber to the dirtiest, worst-looking vagabond in the party, and motioned him to take a good bite. As he put it to his lips, his comrades watched him with breathless curiosity to see how he liked it. For a moment his face wore an expression of blended surprise, wonder and disgust, which was irrisistably ludicrous, and he seemed disposed to spit the disagreeable morsel out; but with a strong effort he controlled himself, forced his features into a ghastly imitation of satisfaction, smacked his lips, declared it was "akhmael nemelkin"—very good, and handed the pickle to his next neighbor. The latter was equally astonished and disgusted with its unexpected sourness, but rather than admit his disappointment and be laughed at by the others, he also pretended it was delicious, and passed it along. Six men in succession went through with this transparent farce with the greatest solemnity; but when they had all tasted it, and all been victimized, they burst out into a simultaneous 'ty-e-e-e' of astonishment, and gave free expression to their long-suppresssed emotions of disgust. The vehement spittings, coughing, and washing out of mouths with snow which succeeded this outburst, proved that the taste for pickles is an acquired one, and that man in his primitive state does not possess it."

Pickles are unwholesome not only because of their utter indigestibility, but because the acetic acid (vinegar) with which they are saturated, is a gastric poison, arresting at once the action of the saliva, and giving rise to gastric catarrh and sclerosis of the liver.

Schibkow has shown that acetic acid is an active poison, behaving like a mineral acid. In some cases death was caused by a few drops. The poisonous effects, when applied to the mucous membrane, began with a 12 per cent. solution. The pulse was slowed and the temperature lowered. The vapor of acetic acid, when inhaled, caused the death of animals either during the inhalation or a short time after.

CHLORID OF SODIUM—COMMON SALT

For centuries the practice of adding chlorid of sodium, or common salt, to many foodstuffs, particularly cereals, meats and vegetables, has been current among civilized people, though by no means universal among primitive tribes. The use of sodium chlorid seems to have been, for the most part, unknown to the North American Indians at the time of the discovery of America, and Indian tribes living remote from civilization, as in the Hudson Bay region and perhaps in a few other isolated localities, still thrive on a saltless diet. The Indians of the Hudson Bay region, when compelled to eat salt beef, soak the meat over night in an abundance of water, turn off the water, then add fresh water and boil for an hour, and then again for a third time place the meat in fresh water to continue the cooking, thus getting rid of the salt flavor of the meat as thoroughly as possible. Millions of natives of Central Africa never taste salt. The great herds of cattle on the western plains are fattened without salt. The Eskimos eat their meat without salt.

Dr. Benjamin Rush, one of the most eminent physicians who has lived in modern times, one of the signers of the Constitution of the United States, who made a careful study of the habits of the American Indians a hundred and fifty years ago, said of salt, "Although the interior parts of our continent abound with salt springs, yet I cannot find that the Indians used salt in their diet till they were instructed to do so by the Europeans."

Among civilized people the excessive use of salt is almost universal. One result of this excess is overwork of the kidneys. Another ill effect is overstimulation of the gastric glands, which are thus led to produce an excess of gastric acid which is formed from salt. The use of salt as an addition to foodstuffs is due to the desire to give to them a more piquant taste. The natives of India use curry, a hot condiment, with their rice instead of salt. Bunge believed that salt is necessary with vegetable foods to take the place of the excess of potash which they contain; but Renmerich and Kurz, by experiments upon dogs, have disproved this theory, showing that the use of foods containing potash salts does not drive out the soda salts but that they are retained by the body in normal proportion.

A story which seems to have originated with an old writer, John Marshall, and which has been repeated by many authors, tells us that the ancient laws of Holland required that criminals should be given bread without salt until they were devoured by worms which developed in their intestines. The story has been in modern times wholly discredited. Numerous persons have discarded salt wholly and lived entirely without it and without suffering any injury. Within recent years it has become the custom of physicians to place persons suffering from epilepsy upon a saltless diet. The salt-free regimen has also been used in other disorders. These persons, when under treatment have discarded salt entirely from their dietary except so far as it is contained in natural foodstuffs, for months at a time and without injury.

Linossier showed in 1900 that three parts of salt added to one thousand of gastric juice retarded the digestion of albumin to the same extent as a 40 to 50 per cent diminution in the amount of pepsin. Three parts of chloride of sodium to one thousand of gastric juice is practically the proportion of salt found in the gastric contents after an ordinary meal. From this it is evident that while the intake of an excessive quantity of salt may increase the amount of hydrochloric acid produced by the stomach, the digestive activity of the gastric juice is diminished.

Salt Hunger.

Persons who have been accustomed to make use of salt, especially those who use it freely, miss it greatly when deprived of it. Such persons especially crave salt with vegetable foods, such as potatoes, and many desire salt with cereals. Few persons, however, go so far in their liking for salt as to demand its use in connection with fresh fruits, though it is often eaten with nuts and frequently with the cantaloup or musk melon, a vegetable fruit which is possesssed of ample flavor to commend it to the palate without addition of any sort.

Bunge, of Basle, advanced the theory that salt is craved with vegetables for the reason that chloride of sodium is found only in small quantity in these foodstuffs, while potash is present in large amount. This theory has not been universally accepted by physiologists, and Carlson tells us that "It is still an open question whether any animal, man included, actually needs sodium chloride in addition to the salts present in all natural foodstuffs. Smith, the veterinary physiologist, maintains that 'both carnivora and herbivora obtain in their natural diet a sufficiency of salts, although there is a general impression that the wild herbivora long for sodium. It is quite certain that under conditions of domestication horses can be kept in perfect health without receiving any sodium chloride other than that contained in the food, and the amount of this in vegetable substances is very small."

The theory that wild animals, especially grazing animals, require salt has been many time shown to be wholly erroneous. The cattle men on the Western plains who raise enormous herds of cattle do not feed salt to their animals. It is well known that the finest oxen raised in Great Britain are not given salt.

Some 25 years ago the writer placed in his small park a pair of deer which have at the present time become quite a little herd. These animals have never eaten salt. On one occasion a new caretaker placed a pan of salt in the enclosure in which they are confined, but they refused to touch it, although they had free access to it for two or three weeks before the error was discovered, it having been intended from the start to rear these deer without salt. On one occasion, when Mr. Seton Thompson was a guest at the Battle Creek Sanitarium, he was invited to see these deer, which he was informed refused to eat salt. He was sure that all deer would eat salt, and was invited to test the deer by offering them salt, which he did. To his great surprise not one could be induced to touch it.

The Tlascalans, one of the tribes of ancient Mexico, were found at the time of the conquest, according to Prescott, to have been for some reason deprived of salt for more than half a century. Prescott adds that it required the lapse of several generations after the conquest to reconcile them to the use of salt with their food. (Conquest of Mexico by Prescott, Vol. I. p. 466.) The same author describes these people as "a bold and hardy peasantry."

The Daramas in southwestern Africa "never take salt by any chance."

Dr. Achard and Professor Richet, of Paris, have in recent years made extensive investigations by which they have shown that while salt is found in the tissues of all animals, it is also found in all vegetable structures and in sufficient quantity in ordinary foodstuffs to supply the needs of the body.

According to these observers, the amount of salt found per 1,000 parts of animal tissues is for different animals as follows:

Insects	6 parts
Birds	7 parts
Land mammals........	7 parts
Sea mammals.........	8 parts
Salt water fish........	20 parts
Fresh water fish.......	8 parts

Human blood contains 8 parts of sodium chloride to 1,000 parts.

The salt leaves the body chiefly through the kidneys and the skin.

The average person takes about two-thirds of an ounce of salt daily. Of this about one-eighth is lost through the skin, most of the remainder through the kidneys. In fasting, salt almost entirely disappears from the urine. Observations on the Italian faster, Succi, showed that after fifteen days of fasting, his urine contained only three grains of salt in twenty-four hours, or about one one-hundredth part of the amount frequently found in the urine.

The use of chloride of sodium raises the blood-pressure. When salt is removed from the body by profuse sweating or by copious water drinking, the blood-pressure falls.

Richet, an eminent French scientist, has shown that the food required for a days ration contains naturally half a dram of salt (30 grains). Numerous experiments have shown that this amount of salt is exactly the amount which the body requires to make good its loss of salt, and that no more is actually needed. In fact, Richet claims that the amount actually required by the body is even less than half a dram. More than this, as this distinguished scientist says, is luxury and not necessity.

Dropsy is produced in the great majority of cases by the excessive accumulation of salt in the tissues; the kidneys being unable to eliminate salt, it is pushed out into the tissues and of course must be held in solution by water. For every half ounce of salt retained, nearly four pounds of water will be retained to hold it in solution. This is shown by the rapid increase in weight when the kidneys cease to eliminate salt.

Javal and Widal have shown that the retention of one-third of an ounce of salt may give rise to edema.

Many observations have shown that the kidneys fail to remove chlorid of sodium at the usual rate in various diseases, particularly in pnuemonia, pleurisy, Bright's disease, some forms of heart disease, erysipelas, typhoid fever, jaundice, cirrhosis of the liver, scarlet fever, smallpox, edema and dropsy. Hence, it is evident that in these disorders salt should be withheld or at least very greatly reduced in amount.

By careful observation it has been found that a marked retention of salt occurs before dropsy or edema makes its appearance. Several cases which have come under the writer's observation are of interest in this connection. The urine of a patient suffering from diabetes in a moderate degree was found to contain no chlorid of sodium whatever, although the amount taken in the food must have amounted to at least one or two drams. Several examinations made within twenty-four hours showed not a trace of chlorid of sodium in the urine. This was the first indication that the patient's condition was serious. In another twenty-four hours the patient was dead, in spite of all that could be done to prevent a fatal termination. The failure of the kidneys to eliminate chlorid of sodium was evidence that these organs had ceased to do efficient work, and the rapid accumulation of poisons in the body resulted in the patient's death, the kidneys evidently being so far damaged that it was impossible to restore them to normal activity.

A patient suffering from cardiac disease was found to be eliminating through the kidneys only a very small amount of chlorid of sodium, less than one grain. This patient likewise died a few hours later. The kidneys were found in an advanced state of degeneration.

Many similar cases might be cited, including a number of cases in which the withdrawal of salt has been followed by the disappearance of the dropsy and other unpleasant symptoms.

If a person eats ¼ ounce of salt and only eliminates ⅛ ounce, salt will necessarily accumulate in his body, and for each eighth of an ounce that is retained, he will have to retain one pound of water to dilute it. If one should stop eating salt, he continues to eliminate it at the rate of an eighth to a quarter of an ounce daily. This causes the elimination of an equivalent amount of water or one to two pints or pounds, and so the person loses in weight. This is what happens in dropsical persons who are put on a saltless diet.

Loufer reports the case of a young girl who suffered from anemia, emaciation, and dyspepsia as the result of the excessive use of salt.

Poisonous Effects from Salt.

The idea that salt is a harmless substance is a grave error. Many persons are doubtless greatly damaged by the free use of salt. Agricultural authorities tell us that two or three pounds is a poisonous dose for a horse and four or five pounds are equally fatal to a cow. A half pound of salt will kill a hog.

An ounce of salt taken in a quart of water produces a decided laxative effect but the use of salt as a laxative is a pernicious practice.

The effects are no different from those produced by the habitual use of mineral water, the laxative effects of which are in large part due to the salt which they contain.

If to a dog is administered one two-hundredth of its weight of salt (a little more than 3 ounces for a dog weighing 40 pounds), the animal falls into convulsions and dies.

Dr. C. Heman Borrow, who spent some years in China, states that in that country "the drinking of a saturated solution of salt is a common mode of committing suicide, and there is none more difficult to treat. In only one case did I succeed in securing recovery. Salt is taken for suicidal purposes sometimes in a common saturated solution made with water as the solvent, and sometimes the brine from salted kraut. . . . The amounts taken vary with the determination of the person taking it, but usually are from one to three rice bowlfuls—half a pint to a pint."

A young woman died after taking a half pound of salt as a vermifuge.

While salt may be used in minute quantities with little if any injury, the amount commonly used is greatly in excess even of reasonable gustatory requirements and should be reduced at least three-fourths.

Tibbles, an eminent English authority in dietetics, tells us that with a diet consisting of cereals and legumes, one-half to one dram of salt is sufficient, and with a diet consisting chiefly of rice a fraction of this quantity is ample. He further adds that very little salt is needed with an ordinary mixed diet; whereas, most people take 20 to 30 grams (two-thirds of an ounce to an ounce) in one way or another. Evidently, the use of salt is merely a concession to an artificial appetite not required except in the case of those who have cultivated a taste for the saline condiment.

According to Gautier, the amount of salt consumed by most persons is at least five times this amount. It is evident, then, that the addition of salt to the foodstuffs is not a physiologic necessity, but is an acquired habit, which is also shown by other facts to which reference has been already made. The excess must be eliminated through the kidneys and skin, imposing unnecessary work upon these emunctories. The free use of salt has been shown by Debove and others to be a serious injury to the digestive process.

Vilhjalmur Stefansson, the Arctic explorer, states that salt is not only not used but is greatly disliked by the Eskimo. He says, "Most people are in the habit of looking upon the articles of our accustomed diet, and especially upon salt, as necessities. We have not found them so. . . . Salt I have found to behave like a narcotic poison—in other words, it is hard to break off its use, as it is hard to stop the use of tobacco; but after you have been a month or two without salt, you cease to long for it, and after six months I have found the taste of meat boiled in salt water distinctly disagreeable. In the case of such a necessary element of food as fat, on the other hand, I have found that the longer you are without it the more you long for it, until the craving becomes more intense than is the hunger of the man who fasts. Among the uncivilized Eskimo the dislike of salt is so strong that a saltiness imperceptible to me would prevent them from eating at all. This circumstance was often useful to me later in our travels about Coronation Gulf, for whenever our Eskimo visitors threatened to eat us out of house and home we could put in a little pinch of salt, and thus husband our resources without seeming inhospitable. A man who tasted anything salty at our table would quickly bethink him that he had plenty of more palatable fare in his own house." Pp. 69, 70, *My Life with the Eskimo,* by Vilhjalmur Stefansson.

The Highlanders of Nepaul refuse to eat salt as do the Kamtschadales.

The native tribes of Siberia have no use for salt.

The Bedouins consider the use of salt ridiculous. The same is true of the Bushmen of South Africa.

Bright's Disease Due to the Excessive Use of Salt.

In the case of a man who died after taking a large dose of salt, marked changes were found in the kidneys, which leads to the conclusion that the habitual use of salt in excess may lead to chronic disease of the kidneys. Bunge called attention to this important fact many years ago.

Says Bunge, "The habit of drinking spirituous liquors, which moreover is reckoned one of the causes of chronic nephritis, also brings about the immoderate use of salt. Thus one sin against nature leads to another. These are questions to which I would direct the attention of practitioners.

"There is no organ in our body so mercilessly ill treated as the kidneys. The stomach reacts against overloading. The kidneys are obliged to let everything pass through them, and the harm done to them is not felt till it is too late to avoid the evil consequences."

According to Torindo, the excessive use of salt is a cause of Bright's disease. It is well known that salt increases the amount of albumen in cases of Bright's disease.

M. Achard, an eminent French physician, also Professors

Strauss, Weidall, Lemierre, and Javal, have shown that in cases of albuminuria the use of salt increased the albumen; by withholding salt entirely, the albumin was made to disappear. Other authorities also completely withhold salt from the food in all cases of albuminuria as well as in cases of latent nephritis in which albumin may not be present.

The great importance of this discovery can only be appreciated when one considers the enormous amount of salt which is used by many persons in this country. In France and most continental countries, salt is used in very much smaller quantities dietetically than in this country.

Recent discoveries which connect the use of salt with Bright's disease of the kidneys will certainly command the thoughtful attention of thousands of thoughtful physicians, who, perhaps, have never before given this matter any serious thought. Salt should be used in exceedingly small quantities, if at all. One can easily accustom himself to the disuse of salt without any great inconvenience, and certainly without any risk to health.

The Salt-Free Diet.

Natural foodstuffs contain sufficient salt to meet all the natural requirements of the body (30 to 60 grains daily —Tibbles), as will be seen by reference to the following table based chiefly upon a table by Strauss, which shows the amount and per cent. of chlorid of sodium per pound found in some common foodstuffs:

TABLE XLIII.

Amount and Percentage of Sodium Chlorid in Foods

Raw Foods

	Per Cent.	Grains Per lb
Milk	.15 to .18	12.6
Butter: Unsalted	.02	1.4
Salted	1.00	70.0
Cheese	2.50	175.0
Egg: Whole (one)	.14	1.0
White (one)	.19	0.8
Yolk (one)	.02	0.5
Meat	.10	7.0
Cereals	.01 to .10	.7 to 7.0
Rice	.01	.7
Oatmeal	.04	2.8
Legumes	.01 to .10	7.0
Peas	.06	4.2
Potatoes	.04	2.8
Vegetables and salads	.10	7.0
Fruit, not exceeding	.06	4.2

Cooked Foods

	Per Cent.	Grains Per lb.
Poached eggs (one)	.50	3.3
Buttered eggs and omelets (one)	2.4 to 2.70	19.0
Roast beef	1.9 to 2.80	200.0
Beefsteak	3.00	210.0
White bread	.48 to .70	50.0
Brown bread	.75	52.5
Cauliflower	qy.	?
Mashed potato	.50 to .91	64.0
Asparagus	2.70 to 3.50	245.0

By reference to the table it will be seen that while milk contains more salt than most other natural foods, it contains much less than an equal amount of any of the ordinary cooked foods. For example, a quart of milk contains 25 grains of sodium chlorid, while the same weight of bread contains two or three times as much, and ordinary salted butter four or five times as much, and cooked vegetables usually contain from five to twenty times as much salt as does milk. A milk diet is thus much superior to the ordinary mixed diet of cooked foods when salt is to be avoided, but is decidedly inferior to *natural* foodstuffs eaten raw or cooked without salt.

The excessive use of salt is without doubt among the causes of several serious conditions. It is particularly harmful in pleurisy, in fevers, in Bright's disease, and has been shown to greatly aggravate the symptoms of epilepsy.

Withdrawal of salt by a salt-free dietary has been found of very great value in the treatment of general dropsy and abdominal dropsy when due either to disease of the kidneys or the heart.

Not infrequently, when salt is withdrawn in cases of dropsy, the excess of fluid disappears almost wholly within a few days.

In obesity, a salt-free diet accelerates the loss of weight.

The elimination of salt is also a valuable means of reducing high blood pressure.

The salt-free diet is especially useful in chronic parenchymatous nephritis with dropsy or edema. It is important to discover the beginning of edematous accumulations in the viscera before external edema develops. Careful comparison should be made between the intake and output of chlorids. If the amount of chlorids found in the urine is considerably less than that of the food, in the absence of profuse perspiration, it may be taken for granted that retention of sodium chlorid is taking place.

It should be remembered, also, that retention of chlorid of sodium may occur without edema, the so-called dry retention. In this condition there is usually an increase of arterial pressure, vomiting, dyspnea, Cheyne-Stokes breathing, diarrhea, and convulsions of an epileptiform character may occur.

Leading European medical journals have reported obstinate cases of eczema in which a cure has been effected by the adoption of a diet free from salt or nearly so.

Salt should be eliminated in diabetes, in syphilis as well as in dropsy from disease of the heart, liver and kidneys.

Mayer mentions salt as one of the causes of war edema.

The excessive use of common salt raises arterial pressures very readily in subjects already suffering from arteriosclerosis, a rise which quickly subsides on the free excretion of salt. The rise of arterial pressure after meals has been attributed to the use of salt.

Tuberculous ascites is treated by Alwens with a diet almost free of salt. He gives gruel, rice, cooked fruit, eggs, milk and non-salted butter with ⅔ gram of table salt for a few days, alternating with a normal diet for a few days. In a large number of cases the ascites disappeared completely after five to six weeks. Unfavorable cases are those in which the process is active and intense and cases with serious complications which influence the nutrition and distribution of water in the body.

It is worthy of note that Dopter has observed that the course of scarlet fever is greatly modified for the better when salt is eliminated from the diet. If nephritis has appeared, which is often the case in severe attacks, it often disappears very promptly when the patient is put on a saltless regimen. These observations have been confirmed by Peter, of Paris.

The saltless diet not only lessens the severity of this disease and lessens the danger of serious complications, but shortens its course. The same is true of all the other infectious diseases and particularly of the exanthems, measles and small pox.

In pneumonia, as well as in typhoid and other fevers, there is a tendency to salt accumulation which seems to be due to the influence of the poisons upon the body cells and not alone to the inability of the kidneys to eliminate the chlorine salt. On this account, the use of salt should be reduced to a minimum if not entirely eliminated in all febrile disorders.

In the salt-free diet the amount of salt should never be permitted to exceed 30 grains daily. In general, the salt-free diet is preferable to the milk diet. Better results are obtained and the patient is better pleased because of the larger variety of food permitted.

To make the saltless fare acceptable to the patient, care must be taken to give the food flavor when salt is omitted by means of lemon juice and other simple and wholesome flavors, particularly raisins and other fruits.

Tea and Coffee

The annual consumption of tea and coffee in the United States amounts to more than 10 pounds of coffee per capita, and one pound of tea. (*U. S. Crop Reporter*).

Besides these, there are used considerable quantities of the cacao bean in the form of chocolate and large quantities of caffein-containing drinks of the Cola type.

According to Thompson, one-third of the total coffee produced in the world is consumed by the people of the United States.

Coffee contains 3 to 9 grains of caffein per ounce; tea, 6 to 8 grains; mate, 5 grains; cocoa, more than 4 grains of theobromine, a close relative of caffein, and Coca Cola, 4 to 5 grains per ounce of the syrup.

Guarana, a South American herb much used as a beverage, contains 17 to 22 grains to the ounce.

Mallet has shown that one cup of black coffee (about two ounces) contains one and three-quarters grains of caffein and the ordinary breakfast cup of coffee and hot milk about two and two-thirds grains of caffein. Dr. H. W. Wiley's analyses showed two grains of caffein in the coffee served at cheap restaurants, and four grains in that served at first-class hotels.

Tea and Coffee are Poisonous Drugs.

Caffein is recognized as a poison by all qualified authorities. The National Standard Dispensatory says that in large doses caffein is "capable of producing marked increase of the reflexes, cramps in the extremities, staggering gait and convulsions of a tetanic character."

The renowned chemist, Lehmann, showed long ago that caffein is a highly poisonous substance. He found that so small a quantity of caffein as 2 to 10 grains "will produce the most violent excitement of the vascular and nervous systems—palpitation of the heart, extraordinary frequency, irregularity, and often intermission of the pulse, oppression of the chest, pains in the head, confusion of the senses, singing in the ears, scintillations before the eyes, sleeplessness, erections, and delirium."

Prof. Lehmann further says,

"The above-named results were yielded by experiments instituted on myself and several of my pupils with pure caffein. Five persons, after taking from 5 to 10 grains of this substance, were unfit for any business during the next day."

The following table shows the amount of caffein found in various caffein-containing preparations:

	Per Cent.
Tea	1.35—1.75
Coffee (roasted)	.75—2.05
Maté	1.115
Kola	2.00
Cocoa (theobromine)	1.00
Coco Cola	1.00—1.2

Chronic Caffein Poisoning.

From the above, it will readily appear that the amount of caffein contained in tea and coffee and their congeners is quite sufficient to produce toxic effects.

In view of the fact that the average daily per capita dose of caffein by the people of the United States is nearly 2.2 grains, it becomes evident that the tea and coffee habit is a grave menace to the health of the American people.

The increasing consumption of tea and coffee in this country, due in part, perhaps, to the prohibition of alcoholic beverages as well as to the extensive advertising campaigns organized by the producers and distributors of these drugs and the highly deceptive and widely scattered announcements of the claims of cola manufacturers concerning the virtues of their pernicious concoctions, renders necessary the warning of the public of the dangers arising from chronic caffein poisoning.

Caffein produces a kind of stimulation which forces the cells of the body to do more work than they would naturally do, but without repaying them by replacing the energy which they expend.

Such stimulation of the cell is unnatural and always harmful. The cell is much like a storage battery. It must be charged before it can discharge. When a battery is fully charged, its voltage is high; it can overcome the maximum amount of resistance, and can do the maximum amount of work. The same is true of the cell. During rest, the cell stores up energy. A rested cell is full of "energy granules," its store of force. The body cells, when rested and well stored with energy, manifest their readiness for work by a feeling of fitness, which is sometimes called "pep." Activity is the natural overflow of accumulated animal spirits, a full charge of vital energy. No stimulus is needed to coerce the living cells to give off the energy with which they are brimming over.

When one feels unfit, the condition that seems to call for stimulation, it is most likely because the cells are lacking in stored energy, like a run down battery. They need charging by food intake or rest, or by both.

The cells may be well charged, but rendered inert or sluggish by stupefying poisons absorbed by smoking or liquor drinking.

Caffein destroys the sense of fatigue, but does not "rest you in five minutes," as the advertisements of poisonous caffein soda fountain drinks declare.

Caffein does not in any way whatever repair the vital losses which result from work. It only increases the losses. This is clearly shown by the fact first pointed out by Dr. Edward Smith, the eminent English authority on foods. Dr. Smith demonstrated that work under the influence of caffein seems easier than without it, but that it is followed by an increased sense of fatigue.

In his two most interesting books, "Across Greenland" and "Esquimo Life," Nansen takes a strong stand against tea and coffee as well as alcohol and tobacco. "After having tried the coffee extract two or three times in the afternoon and evening, and found that, though it cheered them up for a time, they got little or no sleep at night, they first restricted themselves to a morning cup, and then tabooed it altogether." . . .

"My experience leads me to take a decided stand against the use of stimulants and narcotics of all kinds, from tea and coffee to tobacco and alcoholic drinks. It must be a sound principle that one should live in as natural and simple a way as possible, and especially when the life is a life of severe exertion in an extremely cold climate. The idea that one gains by stimulating body and mind by artificial means, betrays, in my opinion, not only ignorance of the simplest physiological laws, but also a want of experience by observation."

Dr. H. H. Rusby, Dean of the College of the City of New

York, Columbia University, and joint author of the "Standard Dispensatory," says, "It is nevertheless true that caffein is a genuine poison, both acute and chronic. Taken in the form of a beverage, it tends to the formation of a drug habit, quite as characteristic, though not so effective, as ordinary narcotics. While not cumulative in substance, it is so in effects, permanent disorders of the cardiac function and of the cerebral circulation resulting from its continued use."

Coffee Raises Blood-Pressure.

The effects of caffein upon blood-pressure are well known. It is, indeed, one of our most dependable drugs for raising blood-pressure in cases of shock, which fact alone is sufficient to condemn its habitual use as a beverage. The average coffee drinker is probably not aware of the fact that in drinking an ordinary "good" cup of coffee he is administering to himself a double medicinal dose of caffein which is rarely more than two grains.

In a paper read before the Massachusetts Medical Society, Dr. Bullard gave an analysis of the various symptoms of tea-poisoning, obtained from the study of a large number of cases. He arrives at several important conclusions; (1) that the action of tea is cumulative, and is most pronounced on the young and those in a depressed physical condition, although persons otherwise healthy not infrequently show poison symptoms; (2) that, as a rule, in adult women, the average amount needed to cause poison symptoms was a little less than five cups daily; and (3) that chronic tea-poisoning is a frequent affection whose most common symptoms are loss of appetite, dyspepsia, palpitation, headache, vomiting and nausea, combined with nervousness, and hysterical and neuralgiac affections, frequently accompanied by constipation and pain in the region of the heart.

The writer has in many cases seen the blood-pressure drop 20 to 40 points in cases of high blood-pressure, as the result of renouncing the use of coffee, and with a notable improvement in health and well being.

Tea, coffee, and the whole family of caffein-containing drugs must be regarded as poisons which especially affect the heart and blood-vessels. The increasing use of these drugs may well be charged with responsibility in part at least, for the notable increase in the death rate from diseases of the heart and blood-vessels which has occurred within the last thirty years, making this class of maladies the chief cause of death in this country at the present time.

"Coffee heart" has become a familiar term with life insurance examiners who know well the damaging effect of this heart poison.

Tea, Coffee, and Uric Acid.

The evil effects of uric acid have long been recognized. It is probable that uric acid is not responsible for all the mischief attributed to it by Haig and others some years ago; but it is an excretory poison which the kidneys must eliminate. The very first indication of failure in the efficiency of the kidneys is an increase of uric acid in the blood. Anything that tends to increase the amount of uric acid in the blood and urine tends to overwork the kidneys and induce their premature failure and also to encourage degeneration of the arteries, (arteriosclerosis) heart, liver and other organs.

It is a fact well known to chemists that caffein is very closely related to uric acid. Both these poisons belong to the same chemical family, the xanthin group. Their effects upon the body are the same.

Professor Mendel and his students made a careful study of the effects of tea and coffee upon the uric acid of the urine. With reference to the results, Professor Mendel says,

"The addition of a strong coffee infusion to a purin (uric acid) free diet causes a marked increase in the excretion of uric acid. The analyses showed that the amount of uric acid after tea drinking was doubled." There is more uric acid (xanthin purin) in a cup of coffee than in the same quantity of urine.

The damaging effect of this increase of uric acid will be better appreciated when the recently ascertained fact is recalled that the human liver does not possess the ability to destroy or detoxicate uric acid, which is an important function of the liver in all carnivorous animals.

Coffee Cripples the Liver.

Tibbles, an eminent English authority on diet, calls attention to the pernicious influence of caffein on the glycogenic function of the liver, which leads him to condemn the use of coffee altogether. This observation suggests that the coffee habit may be one of the causes for the notable increase of diabetes in this country in recent years.

Other Coffee Poisons.

Tea and coffee contain a notable amount of tannin. This is particularly true of tea. Ordinary tea contains 15 per cent. of tannic acid. Assam tea contains 32 per cent. Tannic acid is so highly soluble that it is impossible to make a decoction or infusion of tea which is not strongly charged with this astringent drug, the effects of which upon the stomach are highly pernicious. Tea could easily be used as a substitute for oak bark in the tanning of leather. There is no foundation for the prevalent belief that the tannin may be avoided by making the infusion quickly.

Another point of importance which has recently been brought out by Dr. L. F. Sayre, head of the School of Pharmacy of the University of Kansas, is the fact that the process of roasting coffee develops certain incomplete combustion products, *phenolic* in character, or substances allied to carbolic acid, including *creosote, pyridine,* and a long series of chemically related poisonous substances.

All of these substances, together with certain oils and caffein, give to tea and coffee their toxic properties.

Burmann has shown that the volatile principle of coffee damages the hemoglobin of the blood, depresses the central nervous system, causes irregular heart action, and produces dyspnea.

According to Potter, roasted coffee contains besides, *pyridine* (one of the poisons of tobacco smoke) and *furfuryl,* a substance so poisonous that so small a dose as 1½ grain will produce persistent headache, and 7 or 8 grains will kill a rabbit. An extensive investigation made by Sayre showed that all roasted coffees contain these poisons. The observations by Dr. Sayre with reference to the poisonous effects of the volatile products resulting from partial combustion found in roasted coffees were verified by Dr. Hamilton, head of the Biological Laboratory of Parke, Davis & Company.

Dr. Sayre calls attention to the fact that the starches and sugars of coffee when roasted are in part converted into *furfuraldehyde,* one of the constituents of bad whiskey.

Roasting, also, according to Dr. Sayre, converts tannic acid, always present in coffee, into *catechol,* which is more poisonous than carbolic acid, and *pyrogallol,* which is still more poisonous.

The phenolic substances found in roasted coffees by Dr. Sayre have been shown by the experts of the Lederle Laboratories of New York to have a decidedly harmful effect upon living tissue cells cultivated outside of the body. This most delicate biologic test is a convincing and unanswerable proof of the damaging character of all roasted coffees.

Evidently not wishing to be considered as an enemy of the coffee business, Dr. Sayre naively says, "We should not condemn coffee simply because its toxic principle has been identified more certainly." Certainly not. Coffee is to be condemned not because its toxic principles are known, but because of the bad effects of these toxic principles, which have been clearly demonstrated, not only through the scientific experiments of Dr. Sayre and other experts, but by the clinical observations of hundreds of physicians and thousands of unhappy victims of the coffee habit.

Some Poisonous Effects of Tea and Coffee.

According to Dr. Wm. N. Leszynsky, of New York, coffee is particularly poisonous to children, over-exciting the brain and producing functional disturbances. He says, "I have often seen night terrors, insomnia, tremulousness disappear after the withdrawal of coffee." He attributes to the use of coffee arrest of physical development, and tells of a boy six years of age who suffered from acute coffee poisoning, the symptoms of which were "active delirium, widely dilated pupils, tremor in the facial muscles and the extremities, and severe tachycardia, the pulse rate being two hundred beats a minute." The child also had hallucinations. These symptoms were produced by eating half an ounce of coffee beans.

Doctor Leszynsky also states that the transitory sensation of well-being which is experienced by many susceptible persons after taking a cup of coffee "is soon followed by a feeling of apprehension, general tremulousness, and indigestion." He asserts that the habitual use of coffee in such persons "invariably leads to persistent functional disorder of the nervous system, as well as disturbances of digestion."

Dr. Gilman Thompson, Professor in Cornell University Medical College, of New York City, asserts that the use of coffee to produce wakefulness at night "soon results in forming a coffee or tea habit in which the individual becomes a slave to the beverage" and when deprived of it, "suffers from languor, prostration and restlessness and craving." Two or three cups three times a day produce "muscular tremors, nervousness, anxiety, apprehension, palpitation of the heart, vertigo, heartburn, dyspepsia, constipation, insomnia, and emaciation.''

Doctor Thompson well suggests that coffee users, by suddenly stopping the drug, may discover the ill effects which have been produced. The degree of craving experienced is an evidence of the damage which has been done and of the influence which the drug has obtained over the system.

Gautier, the great French authority, says that coffee produces nervous excitement, insomnia, hallucinations, pain in the heart, distresssed breathing, weakness of the muscles, disorders of the circulation. He says, ''One may become a caffeic (coffee drunkard) just as one may become an alcoholic or morphia maniac.''

Here are some of the poisonous effects as described by Dr. John V. Shoemaker, M. D., Dean of the Medico-Chirurgical College of Philadelphia, and Professor of Materia Medica, as described in his great work on ''*Materia Medica and Therapeutics.*''

''Caffein paralyzes the absorbing power of the convoluted tubules (of the kidney). Small doses cause irritation of the digestive tract, venous congestion and hemorrhoids.

''From a dose of twelve grains (three or four cups of ordinaary coffee) Doctor Pratt experienced restlessness, sleeplessness, mental depression and tremor.

''Zenetz, an eminent German physician, called attention to the dangers of caffein, asserting that three grains two or three times a day (two ordinary cups) cause rise of blood-pressure (leading to apoplexy), constriction of the chest, dyspnea, restlessness. Zenetz has seen death result from five grains two or three times a day. The cause of death was tetanic contraction of the heart.

Miller, Rehfuss, and others, have shown that tea and coffee cause trembling of the hands. This effect of coffee is well known to coffee users. Trembling of the hands may be produced by a single cup of coffee in susceptible persons. This fact alone is sufficient evidence of the dangerous character of this drug. If a certain baker's bread or a particular brand of tomatoes was found to produce such effects, it would be discarded at once. Evidently this is the proper thing to do with coffee.

According to Tibbles, tea deadens the sensation of hunger, inhibits peptic and salivary digestion and causes indigestion, atony and catarrh of the stomach. The following bad effects from the use of tea are also noted by Tibbles: "Insomnia, palpitation of the heart, flushing of the face, muscular tremors, and other signs of nervous irritability.

"Rivers found that an excess of caffein has a very transitory stimulating effect, and may be an accelerator of fatigue, and 'experiments suggest that caffein is a dangerous stimulant in cases of prolonged fatigue or in that tendency to fatigue which characterizes neurasthenia.' Smoking tea in cigarettes is probably the most injurious mode of consuming it, the nervous symptoms being much increased."

Professor Kronecker, an eminent physiologist of Berne, Switzerland, denounces coffee as one of the poisons which is blighting the human race, and urges strongly that tea and coffee, which as he says contain known poisons, should be discarded.

The relief from the sensation of fatigue which follows the taking of coffee is highly deceptive. It gives to the taker the impression that the agreeable beverage has wholly removed the exhaustion of which the sense of fatigue was the signal, and consequently that effort may be continued without injury. This is altogether untrue. As a matter of fact, this effect of tea and coffee in dissipating the sensation of fatigue is one of the greatest dangers which accompanies these beverages. They do not cure fatigue but only hide it by benumbing the fatigue centers so that they are not able to sound the warning signal which indicates that effort should cease, to afford opportunity for repair of the wasted energies. Experiments conducted by Rivers clearly demonstrated that the repeated use of caffein produces the "special tendency to fatigue which is characteristic of neurasthenia."

Tea and Coffee Neurasthenia.

The widespread use of tea and coffee in England and America and in other civilized countries is unquestionably a prolific cause of neurasthenia, especially in women who, on the whole, seem to be more susceptible to these drugs than are men, and who are more addicted to their use.

A man or woman who cannot begin a day's work in comfort without one or two cups of coffee, or who suffers from headache or nervousness when deprived of the accustomed beverage, is a tea or coffee neurasthenic and as much a drug habitué as a person who is addicted to the use of opium or cocaine.

Coffee is without doubt a leading string to other drug habits, particularly the use of alcohol and tobacco. Claude Bernard, an eminent French physiologist, noted that the victims of the opium habit were largely found to be persons who had been much addicted to coffee.

Coffee Insomnia.

Thousands of men and women are suffering from sleeplessness, nervousness, chronic fatigue, indigestion, hardening of the arteries, constipation and various other disorders which are caused, perpetuated and continually aggravated by the habitual use of coffee.

Brillat de Savarin, an eminent French jurist and author of the celebrated work, "*Physiologie du Gout*" (*Physiology of Taste*), thus strongly condemned the use of coffee:

"Every father and every mother should strictly forbid their children to take any coffee, unless they wish to see them shriveled up, bony and withered little things before they are twenty years old."

Savarin tells how that having to do some important work for the Minister of Justice he had to sit up all night. In order not to fall asleep he drank two cups of coffee. He then found he did not have to do the work, and tried to go to sleep. He said, "After being two hours in bed, I felt more wide awake than ever. I was in a very lively state of mental excitation, and I pictured to myself my brain as a mill of which the wheels were constantly going without having anything to grind. I therefore passed the night without sleeping and without feeling sleepy for a single minute. I arose the next morning and passed the whole day in the same state. . . . Finally, on retiring to rest the second day at my accustomed hour, I concluded I had been forty hours without closing my eyes."

This experience was sufficient to convince the jurist that coffee was a nerve poison. He accordingly renounced its use forever.

Tea drinking was mentioned by the Irish Commissioners for Lunacy as a cause for the increasing insanity among the people of Ireland, one of the late results of chronic insomnia and neurasthenia.

Tea, Coffee and Indigestion.

Chronic indigestion is a very common result of the use of either tea or coffee. Caffein overstimulates the acid-forming glands of the stomach, causing acidity and gastric ulcer.

Sick headache, nervousness, trembling of the hands and insomnia, are among the most common of the evil results of the use of tea and coffee.

Roberts found that tea destroys the action of the saliva upon the food and prevents the digestion of starch in the stomach, a serious hindrance to digestion. Tea drinkers are thus certain to suffer from indigestion, through which all the other bad effects of tea are aggravated.

According to the National Dispensatory, a recognized medical authority, concerning the habitual use of coffee, "When taken for a long period of time, it often produces indisposition and acidity of the stomach, due to hypersecretion of gastric juice. In other persons, it tends to produce biliousness, and in still others palpitation of the heart and tremors."

Coffee, like tea, produces insomnia, intermittent action of the heart and even greater impairment of gastric digestion than does tea. Cafe noir is particularly injurious.

Decaffeinated Coffee (Kaffee Hag).

Certain coffee preparations recently introduced are claimed to be free from caffein, but to possess all the other properties of ordinary coffee. Unfortunately, such undue stress has been laid upon caffein as the one poison of coffee, that many persons are likely to be beguiled into the use of these preparations which are only a little less injurious than the ordinary preparations of the coffee bean. It is true that decaffeinated coffee contains caffein only in minute quantities, but in other respects it is like other coffees. Being roasted, it must contain pyridine, catechol and other phenolic bodies more poisonous than carbolic acid, together with various other toxic smoke products,—poisons which in small quantities kill frogs, guinea pigs and rabbits, and have been shown to cause headache in minute doses as well as disturbances of respiration and heart action, and to produce destructive effects upon the blood.

These unwholesome properties are certainly quite sufficient to render decaffeinated coffee unworthy of recommendation as a beverage. Nature has supplied us with pure water, with a great variety of fruit juices and wholesome and harmless flavors quite sufficient to meet all our needs. Tea, coffee and their congeners are all substances which are unattractive in flavor, and the taste for which must be acquired. Even then, the majority of users of these drugs find it necessary to conceal their natural flavors by means of sugar, cream and other more agreeable substances.

Maté.

Efforts have recently been made to introduce into the United States the use of maté, a caffein-containing product of South America. Maté consists of the powdered leaves of a variety of holly, a native of Paraguay. It contains caffein, but in somewhat less amount than tea.

Maté was found in use by the Indians when discovered by the Spaniards. It was introduced into England more than a century ago, but was unable to compete with tea as a mild intoxicant. Its properties are essentially the same as those of tea and coffee.

Coca Drinks.

A prominent medical journal published during the war the following warning against caffein-containing drinks:

"We understand that the Government is interested in the sale of caffein drinks to the soldiers, which are admitted to have done very great harm to them, lowering the morale and injuring the health of the victims. They are conceded to have encouraged crime and immorality.

"But is there not an inconsistency involved in this crusade against caffein drinks, so long as the men are provided with coffee? Why should young and vigorous men in the service be habituated to a powerful stimulant which they do not need, and which is known to be pernicious, while at the same time caffein drinks are prohibited outside the camps?"

Caffein the Cause of Goiter.

Dr. von Wedekind, of the United States Navy, writing to the Journal of the American Medical Association in 1912, called attention to the remarkable frequency of goiter in young men applying for enlistment in the navy. Among the questions asked these young men was, "What beverages do you drink?" and in every case the reply was "Coca Cola." These, with previous observations, led to the conclusion that caffein may be a cause of goiter. It is well known that caffein is the active constituent of Coca Cola.

Soda Fountain Drinks Containing Caffein.

Dr. Wiley has shown that coca drinks contain practically as much caffein as does the same amount of coffee. They are simply flavored decoctions of caffein.

There are mischiefs in the soda fountain preparations which renders them even more dangerous than coffee. These are first, the fact that they are always ready and accessible at any hour of the day and night. Second, that they are generally supposed to be not only innocent of possible harmful effects, but through most alluring advertising are presented to the public as possessing most remarkable beneficent properties. As a result, not only adults, but children are induced to use caffein in the form of a soda fountain beverage, and in large quantities who would never use coffee in the same manner. In other words, the public are beguiled. Cola drinks are an insidious poison, the sale of which should be prohibited by law. Dr. Wiley's campaign against this nefarious traffic was wise and timely, and should have had the support of all medical men.

Coffee Substitutes.

Most coffee substitutes consist of cereals in some form combined with molasses and roasted until a part of the starch and sugar are caramelized. The process of roasting which is always employed, develops in these substitutes poisonous phenolic and other smoke products the same as are produced in ordinary coffee. These substances may be present in such quantity as to cause nausea and vomiting. Of course, caffein is not present in cereals. But cereal coffees charged with smoke poisons may be the source of as much harm as that which usually results from ordinary coffee.

In the writer's opinion *roasted* cereal coffee substitutes are unwholesome and cannot be recommended. The best plan is to overcome the coffee habit by getting rid of the taste for coffee instead of cultivating a taste for a substitute. If a substitute is insisted upon it should be prepared without roasting. The writer knows of only one coffee substitute which is prepared in this way and which can be recommended as safe. This is a cereal beverage which is prepared by a process which does not involve roasting, so that there is no opportunity for the development of the harmful phenolic bodies or smoke poisons which are present in all roasted coffees, including coffee substitutes prepared from cereals.

TOBACCO

Smoking after or in connection with meals has become so common a practice that a brief reference to this pernicious habit seems proper in a work devoted to nutrition and dietetics. Tobacco is by no one claimed to be a food, although value has been claimed for it on the ground that by its use the consumption of food is lessened. This means nothing more than that by its poisonous effects the activities of the body cells are interfered with, certainly not a useful property.

The Effects of Tobacco.

Tobacco smoking produces a sort of comfort or solace because of its narcotic or sedative effect upon the nerve cells, especially the cells of the higher cerebral centers which are concerned in thought. The continued use of tobacco, however, as has been pointed out by Tibbles, "causes degeneration of the same cells (brain cells), and thus leads to loss of power of thought, enfeeblement of the attention or power of concentration, and deterioration of the memory."

Rivers demonstrated by means of the ergograph that tobacco has a most unfavorable influence upon capacity for muscular work. Lombard, Professor of Physiology of the University of Michigan, demonstrated the same toxic influence of nicotine upon the muscles. He demonstrated that a single cigar lessens muscular power for many hours.

The tobacco habit leads to serious impairment of the movements and secretions of the stomach and intestines and it gives rise to dyspepsia, gastric catarrh, and impaired nutrition. Under the influence of this drug the body cells act with less vigor, metabolism is reduced, and all the life processes are slowed.

Tobacco a Heart Poison.

The first effect of a cigar is to raise the blood-pressure and slow the pulse, but this effect is later followed by a quickening of the pulse. The pulse of the old smoker becomes irregular, and myocarditis and other changes in the heart are produced. According to Tibbles, "the juice from 22 pounds of tobacco yielded 2.2 pounds of *nicotine*, two-thirds of an ounce of *nicoteine*, one-sixth of an ounce of *nicotinine* and 15 grains of *nicotelline*," all deadly poisons.

Angina abdominis, a form of angina affecting the vessels of the abdominal organs which is characterized by crises of very severe abdominal pain, has been shown to be one of the consequences of smoking.

French tobacco contains 7 or 8 per cent. of nicotine, which is the principal poison of tobacco. In Kentucky and Virginia tobacco 6 to 7 per cent. of nicotine is found. Smoking partially destroys the nicotine, 50 per cent. of it remaining. The smoke contains besides nicotine, *pyridine, hydrocyanic acid, ammonia. carbon monoxide* and numerous other poisons.

The highly poisonous effects of carbon monoxide are well known. Carbon dioxide, or carbonic acid gas, is a comparatively harmless poison. It is, of course, irrespirable, and in pure or rather concentrated form will produce asphyxia; but carbon monoxide is deadly in minute doses. It is found in considererable quantity in cigarette smoke, as shown by Hartridge (Journal of Physiology, 53). This investigator has shown that heavy smokers are in a state of chronic carbon monoxide poisoning.

We are glad to be able to quote the following keen and thoroughly just criticism of the tobacco habit from so eminent a medical authority as the *New York Medical Journal* (Feb. 2, 1918):

"*Psychical Pharmacology of Nicotinism.*—Of the three principal narcotics used in this country, nicotine for several reasons leads in popularity. One of these reasons is that nicotine most quickly satisfies the longing of the storm tossed "mental" and of the inept neuron. Tolstoi said that after the first whiff from his pipe *he no longer felt the prick of conscience.* To be able to banish care is, to a jaded mentality, the one supreme requirement of a narcotic. Nicotine exalts the ego. The nicotine-enthused and flattered ego feels like advertising its way of taking a narcotic. The user actually feels that everybody likes, or at least ought to like, everything that goes with his use of nicotine. To him it is entirely unbelievable that a sane person can object to any feature of its use. The grandeur intoxication prompts the customary good natured obtrusion of the practices of nicotinism into the presence of others. As care flees away in the intoxication, there comes in its stead a feeling of being at peace with the world. The narcosis grants the peace, but the condition of peace always is that the use of nicotine is not to be interfered with. Because the narcotic effect is upon the ego itself, inflated ideas as to personal estimation of the meaning of the intoxication and resentment to any and all criticism of nicotine are very acute.

"The reactions of public opinion to these features of the narcosis are favorable to the public use of nicotine. This accords with the psychological law, that the mind is likely to be captivated by that which presents a bold front of assumed sincerity. Public opinion does not give the matter study before it sanctions the public use of nicotine, but the use forces itself upon the public, and as nonendorsement of the narcotic act means a fight, the peace-loving instinct in man surrenders to nicotine. The medical matter involved is that the end results of nicotine narcosis are never as good as the non-narcotized man would have been capable of. Besides, its use violates every principle of scientific medicine."

The tobacco habit has obtained almost a strangle hold upon society in every civilized land and is rapidly invading the countries just emerging from a less sophisticated and possibly less culpable heathenism. Sometime the hold will be broken and this pernicious drug habit, a gigantic curse of modern civilization, will be cast off as a handicap which a degenerating race can no longer tolerate. Already, forces are at work which within a quarter of a century, if not sooner, will so discredit the delusive drug that its condemnation by sane and intelligent men and women will be universal. One of the most important of these agencies by which this good work will be accomplished we believe to be "The Committee of Fifty to Study the Tobacco Problem," which has initiated and is carrying forward important researches on all phases of the tobacco question as related to human welfare, physical, mental and moral, by the aid of scientific experts of such national and international standing that their findings, when published, and the ultimate verdict when rendered, will be above and beyond dispute or refutation. A similar authoritative scientific inquiry on the alcohol question laid the foundation for prohibition and the overthrow of the saloon; and a like inquisition followed by a nationwide educational campaign, will in due time abolish the smoke nuisance, a thing too impudent and offensive, to say nothing of its insidious destructiveness, to be tolerated by a decent and rational society.

Ptomains—Poisoned Foods

Ptomains are poisons produced by the decomposition of protein. They are particularly encountered in decomposing animal foodstuffs, and especially in flesh that has been too long kept after the slaughter of the animal. Some of the ptomains are highly virulent poisons. The most deadly are likely to be found in sausage, hamburger steak, game, and chickens, turkeys, ducks and geese which have been long in cold storage.

Ptomains are produced in the early stages of decay and so may be present before there is any taint of decomposition perceptible to the senses. On this account it is, in the writer's opinion, important that all meats, including fish, should be examined bacteriologically before using as food. Meat may be swarming with putrefactive, ptomain-producing bacteria when only recently killed—within a few days—and when apparently perfectly fresh. Such meat should be condemned.

Oysters and mussels may contain deadly ptomains when fresh, doubtless because they are scavengers and subsist upon the offal which they find in the water, especially about river mouths.

There are more than 60 different ptomains known, of which may be named, *cadaverine, putrescin, butylamin, amylamin, neuridine, saprin, sperium, mydalein, cholin, neurin, muscarin, betain, gadinin, mytilotoxin, callidin, parvolin, corrindin, morrhuin, asellin, typhotoxin, tetanin, spasmotoxin, telanotoxin, pyocyanin, tyrotoxicon.*

Among the most deadly of these are cadaverin, putrescin, neurin, neuridin, and cholin, found in stale meat and fish; mytilotoxin, occurring in oysters and other shell-fish; muscarin, found in meat and mushrooms; and tyrotoxicon, the deadly cheese poison, sometimes found in milk and ice cream.

This is certainly a formidable array of deadly agents nearly all of which may be escaped by avoiding flesh foods, which under all ordinary circumstances must be regarded as wholly unnecessary additions to the bill of fare.

Food Toxins

Besides ptomains, there may occur other deadly poisons in food known as toxins. These are the result of the growth in animal tissues, either before or after slaughter, of germs which cause specific infections. One source of food toxins is a germ which gives rise to botulism. This germ grows readily in fish and meats which have not been properly processed in canning. It has also been found in spoiled canned beans, spinach, and ripe olives canned in glass.

Animal foods are especially liable to contamination with poisons which may be produced by the action of either specific germs or the ordinary organisms which produce putrefaction. Sausages, potted meats, fish, oysters, lobsters, eels, canned meats which have spoiled in the can or been allowed to stand after opening, often contain poisons which produce very severe and often fatal illness.

Meat poisoning often results from the ingestion of Gärtner's bacillus in cold storage meats. It most frequently occurs as the result of eating pork, veal, fowl, beef, or ham.

Fish poisoning may result from the use of fish that are partly decomposed or diseased, or which have spoiled in the can, either before or after opening, or it may result from the use of fish of certain species which are always poisonous. Fish sometimes become poisonous through feeding on decomposing corals and other poisonous substances.

Poisoning often occurs as the result of eating shellfish which contain a special poison, mytilotoxin. Shellfish are scavengers and thrive in the vicinity of the outlets of rivers which receive the sewage in large cities. Typhoid fever and other germs are found in the intestines of shellfish. Oysters strain the water through their gills and capture great numbers of bacteria and other organisms as well as particles of decomposing matter. The poison found in these creatures is chiefly concentrated in their livers.

Oysters and shell fish of all sorts are always swarming with bacteria. Oyster juice is fairly alive with the wriggling bacilli. Raw shell fish are too unclean to be given a place in any stomach except that of a scavenger.

Other virulent poisons have been found in the flesh of animals which when slaughtered were suffering from pyemia, septicemia or specific enteritis.

The flesh, milk, and dairy products from cows infected with foot and mouth disease, particularly the use of cheese, butter, and milk may give rise to the same disease in human beings.

Acute poisonings from animal foods are frequently seen in the sickness which follows the use of herring, pickled fish advanced in decay, particularly stale oysters, salted sturgeon and tainted horse flesh.

The flesh of hunted animals often becomes poisonous through the entrance of the *B. coli* into the blood before death.

Cold storage meats sometimes become poisonous from the slow decomposition which takes place even at temperatures only a little above freezing.

Rouennaise ducks are rendered poisonous by the peculiar way in which they are killed. They are killed by a puncture of the medulla, which causes death without loss of blood. They are afterwards beaten, causing absorption of intestinal bacteria and poisons which are diffused throughout the body.

Hamburger Steak.

The following conclusions drawn by Weinzirl and Newton after a careful bacteriological investigation of hamburger steak and other meats would seem to condemn this popular commodity as being unfit for human food and to cast strong suspicion upon other products of the butcher shop as well.

"The standard of 1,000,000 bacteria per gram, advocated by some as a limit, is apparently too low, *since it would condemn nearly all samples of hamburger,* when showing no taint or other evidences of putrefaction. Samples of other market meats, all of which would otherwise pass inspection, often exceed this limit." "A bacterial standard of 10,000,000 per gram as the limit is proposed, on the basis of which 50 per cent. of the market samples of hamburger would still be condemned. This is justified on the following grounds: (a) much of it is actually spoiled when it reaches the consumer or is to be cooked; (b) meat teeming with 10,000,000 bacteria per gram is potentially rotten and soon will be actually spoiled under ordinary methods of handling; (c) the fact that markets are prone to add sodium sulphite to hamburger, even though the dealer knows it to be contrary to law, indicates that something is wrong with the hamburger; and (d) finally, if hamburger were made from wholesome meat in the first place, then kept properly iced, it is believed that the bacterial content could readily be held within the 10,000,000 limit."

It is evident that whether the standard be 1,000,000 or 10,000,000, it is a question of degree of rottenness, since the lower standard named means not less than 300,000,000 bacteria per ounce, and bacteria of the most objectionable class, including *B. Welchii,* the terrible organism of gas gangrene. Hamburger steak is carrion, and quite unfit for food except by a turkey buzzard, a hyena, or some other scavenger.

Poisons in the Flesh or Milk of Sick or Overworked Animals.

The flesh of a horse which was killed in the effort to break him was fed to hogs. The hogs sickened and died. (Kahnert).

The flesh of a deer caught in a trap and killed by its efforts to escape was the cause of sickness in a large number of persons who ate of it. The infant of an overworked mother showed marked symptoms of poisoning which disappeared when the child was nursed by another woman.

It has long been known that the flesh of overworked animals undergoes putrefaction very rapidly after death. It is even possible that in such cases the tissues of the animal may be pervaded by bacteria during life on account of the greatly lowered resistance which results from overwork. It should be generally known that the flesh of an animal subjected to violent exertion or overwork before killing is absolutely unfit to eat. Without doubt, many such animals find their way to the market.

Some years ago the people of Boston were very much disturbed by the discovery that animals which had been condemned by the State Board of Health because of infection with tuberculosis were sold in their markets. Investigation showed that such animals were regularly disposed of for food purposes. The defense of the Board was that the same practice prevailed in other states and was recognized as legitimate by the U. S. Department of Agriculture. This repulsive practice seems to be general.

A case was reported by Bollinger in which sixteen persons were made sick by eating sausage made from the body of a pig which had received arsenic as a remedy.

It should always be recollected that fish are scavengers, and when caught in waters near the mouths of sewers are very likely to be infected by the sewage which they greedily consume as food.

Poisonous substances are found in the flesh of animals which have suffered from apoplexy, especially hogs, animals which have died of indigestion and which have been affected with dropsy or infectious disorders. Poisons of this sort are not destroyed by cooking and have given rise to symptoms in human beings resembling cholera or typhoid fever. Of more than one hundred people who ate of a cow that had died of puerperal fever, half were made very sick.

The flesh of animals which have suffered from disease of the lungs, from enteritis, peritonitis, nephritis, and hepatic affections, always contain poisonous substances and are wholly unfit for food.

Dr. Weseberg reported some time since an epidemic of meat poisoning in which 63 persons became seriously ill as the result of eating the flesh of a cow which had been killed because of pericarditis resulting from an accident. The persons who became ill had eaten of minced meat prepared from the animal and also portions of the cooked liver. The symptoms resulting were violent headache, severe abdominal pain, dizziness, muscular weakness, diarrhea and vomiting. Bowel discharges were highly offensive. Mice inoculated with portions of the meat died within one to three days, with symptoms similar to those shown by the persons who had eaten of the same flesh.

When the fact is recalled that all the flesh sold in the market, and practically all that is eaten, is swarming with the bacteria of putrefaction, the wonder is that the number of persons who suffer from acute symptoms of poisoning after eating flesh is so small.

Milk from Tuberculous Cows Poisonous.

When it is recalled that in the most favored portions of the United States 5 to 10 per cent. of all the milch cows are tuberculous, while in many states the proportion of infected animals reaches 25 per cent., some idea may be formed of the enormous mischief done by the use of the milk of tuberculous cows. Milk should be regarded as unsafe for use as food unless known to be produced by cows proven by Federal inspection to be free from tuberculous disease.

Roger insists that too much precaution cannot be taken against the use of the milk of tuberculous animals, since the cooking of milk does not render it harmless. The researches of Calmette and Breton demonstrate that the ingestion of dead germs may produce a fatal cachexia. Even though it contains no bacilli, the milk of tuberculous cows should be rejected. When such milk is given to young rabbits or injected under the skin of guinea pigs, the animal falls promptly into a state of cachexia and marasmus. The experiments of Pasq. de Michele show that such milk contains poisons which are not destroyed by boiling or by digestion.

Poison in Clams.

Soper says, "It is not unusual to see persons digging hard clams close to the mouths of sewers. After a very short period in market this form of shellfish is often eaten raw. Hard clams are particularly in favor during those warm months when oysters are out of season and diarrheal diseases are most common. It would not be at all surprising if many outbreaks of diarrheal disease at seaside summer resorts were traceable to hard clams taken from nearby polluted sources.

"Heavily polluted shores are among the most prolific sources of soft clams, and large quantities are annually taken from situations of this kind."

Typhoid from Oysters.

An investigation made by Klein and Boyce of typhoid fever epidemics in Brighton, England, traced the disease to the use of oysters. Sewage bacteria were found both in the oysters and in the mud. The proportion of cases definitely traced to the use of oysters was in 1894, 38 per cent.; in 1895, 34 per cent.; in 1896, 32 per cent.; in 1897, 31 per cent., certainly a proportion sufficiently large to condemn the oyster as a food under any condition except the absence of any more wholesome sustenance.

Poisonous Ice Cream.

The unwholesomeness of ice cream, on account of its low temperature and depressing influence upon the activities of the stomach, has long been appreciated, but the great danger of infection from this source has within the last few years been made clear by bacteriological studies conducted in the biological laboratory of the city of Philadelphia by Drs. Pennington and Walter. Physicians constantly meet cases of disease of the stomach, both acute and chronic, which are directly traceable to the use of ice cream. This matter is especially important in view of the large amount of ice cream consumed by young children and invalids and its extensive use in connection with soda water.

It was found by Drs. Pennington and Walter that the *streptococcus,* a pus-forming organism which is always found in ice cream, is the principal cause of the acute disorders directly traceable to its use. Escherich, Kaiser, Petroschky and others, have called special attention to the dangerous character of the streptococcus found in milk, and attributed to this microorganism a large part of the infant mortality which occurs in the summer time. Heynemann found that the streptococci of milk readily take on the highest degree of virulence, especially in persons whose resistance is low. There are many such persons who show signs of bacterial infection whenever they eat ice cream. In the special research above referred to, streptococci were found in 80 per cent. of the samples examined. Of 50 per cent. of the samples examined, all but three contained more than 500,000 microorganisms per c. c. (15,000,000 per ounce).

Ice cream is usually made from stale cream. It is cheaper, and it is claimed makes better ice cream than fresh cream, because it is near the souring stage. The pasteurization which ice cream makers give the cream rather encourages the growth of bacteria by the increased temperature, as the presence of fats protects the microorganisms from the heat, so that a higher temperature is required than that used in pasteurization to kill the bacteria of milk. It is more than probable that the cheap ice cream which is sold in the summer time is largely responsible for the wide prevalence of diarrheal disorders at this season.

Cheese Bacteria.

Professor Adametz made some years ago an interesting study of cheese, in which he identified nineteen varieties of bacteria which are ordinarily active in the ripening of various sorts of cheese. Some of these bacteria are furnished by the milk, others are derived from the vessels in which the milk is kept, still others from the air and from the rennet ferment added to the milk in the process of cheese-making. In certain cases molds or other fungi are added, as in the case of camembert cheese. Adametz estimated the number of bacteria in cheese to be about twenty-five million germs to the ounce. Roquefort cheese is made by adding to the curd of milk, mold from a dough made from barley flour, with which yeast and sometimes vinegar has been mixed. The mold which forms on this dough when allowed to stand, is rubbed into a powder and added to the milk. Gorgonzola and Stilton cheese are made by the same process. The mold consists of several varieties of fungi, one being the common green mould frequently found in bread and other food kept in warm moist places. Einhorn has shown that these molds sometimes take up their abode in the stomach, form colonies on the mucous membrane, and thus become a cause of grave disease.

Cheese Poisoning.

Cheese poisoning is due to tyrotoxicon. This was discovered by Vaughan thirty-seven years ago (1883). A large number of cases of cheese poisoning, some three or four hundred in all, had then been reported to the Michigan State Board of Health. At the suggestion of the writer, at that time a member of the Board, Dr. V. C. Vaughan, of the University of Michigan, was asked to make a special research for the purpose of ascertaining, if possible, the cause of the poisoning. After some months of careful study of the subject, Dr. Vaughan announced the discovery of *tyrotoxicon*, a ptomain which, in minute doses, produces vomiting and purging, pain in the region of the stomach, feeble heart action, cyanosis, and in larger doses speedy death. Cheese containing this poison does not differ in appearance from ordinary cheese, and to the taste and smell of human beings gives no indication of being unwholesome, the distressing symptoms appearing some hours after it has been eaten. But cats and dogs, which readily eat ordinary cheese, at once recognize the poisoned cheese and refuse to eat it. Cats die quickly in convulsions when injected with small doses of tyrotoxicon.

Poisons in Plant Foods.

Plants sometimes absorb poisons from the earth. Paul Bert watered radishes with water containing strychnia. The radishes accumulated so much strychnia that they killed the animals to which they were fed.

Poisonous mushrooms may cause death from the muscarin which they contain. The poisonous mushroom is much used in Siberia for preparing an intoxicating drink. This form of intoxication is so pleasing to those addicted to it that, according to Roger, "The poor do not hesitate, it appears, to drink the urine of the rich in order to enjoy the same pleasures."

The Poisons of Molds.

Certain molds produce poisons, particularly black and orange molds, which cause vertigo, colic, sweating and even coma, symptoms similar to those produced by the poisons of the mushroom. These poisons are destroyed, however, by oven heat.

M. Pietro, an Italian investigator, in the study of pellagra, made the discovery that the common green mould known as *pennicilium glaucum*, produces a highly toxic substance in its spores. This toxin is active when introduced into the stomach or under the skin. Dogs, rabbits and guinea-pigs are sensitive to its effects as well as human beings. The poison of green mould produces muscular trembling, paralysis, spasms and other symptoms which in many respects resemble those present in pellagra.

Moldy grain and flours prepared from such grain may give rise to poisoning from the specific poisons developed by molds.

Lathyrism.

This is a form of poisoning produced by the chick-pea. It has sometimes occurred as the result of eating flour adulterated with the chick-pea. This disease is sometimes known as lupinosis.

Ergotism.

This is a form of poisoning due to the eating of grain, particularly rye, infected with "smut." In the Middle Ages severe epidemics of this disease, then known as St. Anthony's, occurred at various points in Europe. In recent times epidemics have occurred in Russia.

Actinomycosis.

This is a parasitic disease which sometimes somewhat resembles cancer in its gross appearance. It may give rise to abscesses in bones, in the brain, or in the liver. Its origin is not well known. It probably originates through contact with cattle.

Infected Vegetables.

Melec has shown that radishes grown in contaminated soil showed infection after 28 to 37 days, lettuce, after 21 days. The bacteria were found only on the outside of the plants, and were not removed by ordinary washing. This shows the necessity for disinfection with peroxide of hydrogen or hydrochloric acid, or chlorine. (See page 313).

The Germs of Fruit Skins.

Professor Ellen H. Richards, of the Massachusetts Institute of Technology, made some years ago a study of the condition of fruit found on open air fruit stands. A pint of various fruits taken at random from a stand were washed and a bacteriological examination made of the washings. 140,000,000 germs were obtained from this single pint of fruit. Fruit thus exposed to street dust is certain to collect a great number of germs derived from the excreta of animals and other dangerous sources, and is quite unfit for food. Market fruit should be disinfected by washing and soaking five minutes in a solution of fresh chloride of lime, a teaspoonful to the gallon.

Infection from Flies.

Fruits and other foods may become a source of infection through the medium of flies. Flies are in the summer always liable to be carriers of infection. Epidemics of typhoid fever have not infrequently developed through the medium of flies. Hence, these pests should be carefully excluded from kitchens, pantries and dining rooms, and should never under any circumstances be allowed to come in contact with food.

Ladd reports the results of an examination of grapes in which "The grapes from the outside of the cluster were found to bear colon bacilli, approximately 100 colon bacilli per grape.

Botulism.

The increasing prevalence of this disease, outbreaks of which are now frequently appearing in different parts of the country, renders it necessary to be sharply on the lookout to prevent serious or even fatal poisoning. This duty is especially encumbent upon proprietors, dietitians and chefs of hotels, restaurants, boarding houses and other eating places, and especially hospitals, and other institutions where canned vegetables are much used.

Botulism is a disease due to poisons produced by spore-forming organisms of which there are two types, A and B. The germs themselves do not grow in the human body; hence the effects are produced by the poisons already developed in the spoiled food, the eating of which is the cause of the disease. In former times attacks were usually the result of eating spoiled salmon, sardines or some other sort of canned fish or meats. More recently, attacks have resulted from the use of canned beans, beets, olives or spinach. The cans are usually bulged and the contents have an unpleasant flavor and offensive odor. An offensive odor is not always present, however.

The cause of botulism appears to be lack of cleanliness, the use of decomposing materials, and insufficient processing. If the goods are processed at a sufficiently high temperature (240° F.), the spores as well as the germs which produce them will be destroyed. When the cans are not heated at a sufficiently high temperature, the spores are left viable and later develop, producing the highly virulent poison characteristic of B. botulinus. Fortunately, thorough heating at the boiling point will destroy the poison. In the outbreaks which have occurred, the foods have been eaten cold or have been insufficiently heated When cans are bulged or "flip," the goods should be promptly rejected no matter whether an offensive odor is present or not. The slightest taint should always lead to the rejection of canned goods; but even when no evidence of spoiling is present, it is necessary for entire safety to subject canned vegetables of all sorts to thorough boiling before serving.

Dr. Robert Graham has recently shown that *B. botulinus* is often present in flour, though fortunately not in a state dangerous to human life.

When an attack of botulism occurs, one of the first symptoms is double vision. Headache, more or less gastric disturbance and a peculiar feeling in the throat with difficulty in swallowing are characteristic symptoms. Drooping of the eyelids is another prominent symptom, and great prostration in severe cases. Sometimes there is a disappearance of the symptoms shortly after the beginning of an attack. The patient may feel well enough to resume his usual duties; but after twenty-four hours a relapse may occur. Fever is usually absent.

The symptoms of botulism may be so mild as to be hardly noticeable. In other cases the attack may prove rapidly fatal.

At the present time more can be accomplished by prevention than by curative measures after an attack has developed.

The disease is very frequent among fowls, cattle and horses, among whom it is known under various names, such as "limber rock," "blind staggers," "corn stalk disease," "forage poisoning," etc.

Parasitic Infection of Foods.

Certain foods, particularly animal foods, are liable to become injurious to health through the presence of parasites. Among the parasites which may be present in foods, either in the form of ova or in the young or adult state, are the following:

Ameba coli, which gives rise to dysentery.

Coccidium oviforme, derived from the eating of infected green vegetables or contaminated drinking water and the handling of domestic pets, which are likely to carry this parasite.

Liver fluke, (distoma hepaticum), derived from aquatic plants. The infection occurs through drinking water. The parasite is found in the gall-duct and the gall-bladder.

The blood fluke, (bilharzia), found in the urine. Probably derived from drinking water. It occurs especially in Egypt and is often fatal.

Whip worm, (ascaris), a common parasite in the tropics derived from water or infected raw vegetables.

Pin or thread worm, (oxyuris), infects the lower extremity of the small intestine. Descends to the colon and rectum. Enters the body with raw fruit or other uncooked foods.

Pork tapeworm, (tenia solium), a parasite derived from raw or uncooked pork (measly pork).

Beef tapeworm, (tenia saginata), a parasite derived from the eating of raw or undone beef (measly beef).

Tenia echinococcus, a parasite which is found in the intestines of dogs. It is communicated to human beings by the handling of dogs or the eating of infected raw, green vegetables.

Bothriocephalus latus, a tapeworm derived from fish, common in northern Europe but rare in the United States.

Hookworm, derived from infected water or through abrasion of the skin, especially of the feet.

Filaria sanguinis, a parasite which gives rise to elephantiasis. It is derived from impure water.

Trichina spiralis, a parasite derived from pork which develops in the muscles. The hogs in this country are so generally infected that the United States Government has issued repeated warnings against the eating of pork which has not been thoroughly cooked. The disease has become so widespread that no attempt is being made to control it, and there is no inspection of pork sold for consumption in the United States.

Adulterated Foods.

In general, wholesome foods are little adulterated. The pure food law, has, in fact, almost wholly suppresssed the adulteration of foods of any sort in this country. The articles most likely to be adulterated are mustard and spices, pickles, coffee, tea, and cocoa. Butter is sometimes adulterated with oleomargarine, lard, beef tallow, fats, and oils. Olive oil is frequently adulterated with cottonseed oil, and strained honey is sometimes adulterated with glucose. None of these adulterations, however, are particularly harmful. The most harmful adulterations are those which consist of the use of preservatives, such as sulphurous acid, sulphites, sulphates, salicylic acid, benzoic acid, and formaldehyde in foodstuffs. These preservatives are often added to canned foods. All of them are harmful. Boric acid and borax, which are frequently used, have been shown to be injurious to digestion. Copper, iron, and nickel are sometimes used to improve the color of pickles, green peas and other vegetables. Zinc occurs in dried apples as the result of using galvanized iron pans in drying. Jams and jellies are adulterated with aniline colors and with agar, turnips, apple or gooseberry pulp.

Benzoate of Soda.

Benzoic acid is much more toxic than benzoate of soda, just as hydrochloric acid is more poisonous than sodium chlorid or common salt. It should be noted, however, that the experiments on animals which seemed to show the benzoate of soda to be harmless cannot be taken as evidence of the effects in man, who is much more susceptible to these poisons than are lower animals.

The facts now known concerning the poisonous properties of benzoic acid and benzoate of soda are certainly sufficient to condemn its use as a preservative. It is to be hoped that the Federal Pure Food Department will soon see its duty to prohibit the use of this drug in foodstuffs, especially as it is so often used to conceal the inferior character of the raw material used, and further, in view of the fact that it is almost exclusively used in the preservation of hot sauces which are an unnecessary and often highly injurious addition to foods.

Toxicity of Certain Foodstuffs.

Recent experiments by Cook on the toxicity of foodstuffs have given some most interesting results. Frogs and gold fish were the subjects used. Cane sugar, the acetic acid of vinegar, the potassium oxalate of rhubarb, alcohol and Rochelle salts, the residue of baking powder, all were found to be toxic. Sodium benzoate was found to be much more toxic than oxalic acid or potassium oxalate of rhubarb. Cane sugar was found to be three times as toxic as grape sugar.

Keeping the Soil Clean.

One of the advantages of cookery is the fact that it lessens the danger from infection with disease-producing bacteria. Fortunately, cooking at ordinary temperatures will destroy most of the bacteria which produce disease and in some cases cookery destroys the poison produced by the germ as well as the germ itself. Consequently, the cooking of food is in no small measure a protection against infection by disease-producing germs, such as typhoid fever, tuberculosis, cholera and various water-born diseases. There are a few germs, however, which are not destroyed by ordinary cooking for the reason that they produce spores which are highly resistant to heat. Some of these spores resist a temperature as high as 240 degrees for a few minutes without being destroyed and require heating for 40 minutes at the high temperature named for their destruction. Of germs of this class which are dangerous to human life, the bacteriologists especially mention four—the bacillus which produces tetanus, or lockjaw; Welch's bacillus, which causes gas and putrefaction and gives rise to gas gangrene in infected tissues; the bacillus *botulinus,* which causes botulism, and the anthrax bacillus, which causes malignant postule.

The tetanus bacillus usually finds access to the body through wounds. The bacillus of gas gangrene is likewise due to infection of the tissues with Welch's bacillus through a wound of some sort, usually either the bite of animals or a wound received in battle. Welch's bacillus, however, finds its entrance to the body through the mouth with certain foods. It is always present in meats, which as obtained from the butcher shop are infested with putrefactive bacteria of various sorts, among which is the gas gangrene bacillus. These bacteria, when introduced with the food, find in the colon a favorable opportunity for development and are the chief cause of the putrefactive changes which occur in the colon and which give rise to gas formation and the development of offensive odors. This bacillus is thus largely responsible for the intestinal toxemia or autointoxication which is always present in cases of chronic constipation, although the characteristic symptoms which result from various kinds of damage to the body are sometimes slow in developing.

These most pernicious organisms, some of which are the most deadly with which the human organism comes in contact, find in the colon of animals the most favorable place for their development. The bacillus of lockjaw apparently grows with a special luxuriance in the colon of the horse. It is thus evident that the use of manure as a means of fertilizing the soil is also a source of infection of the soil. It is for this reason that stepping on a nail is a common cause of tetanus. Either the nail or the unprotected foot is very likely to be more or less soiled with dirt, and if the earth has been infected, through fertilizing with animal manure, the tetanus germs are very likely to be present.

A recent experience shows that soil may become infected with B. *botulinus,* the cause of botulism, in a similar manner. The owner of a small garden for eight years canned string beans grown in his own garden, with excellent success. There was no spoilage and no sickness due to the use of the beans. In 1918 animal manure was used as a fertilizer. The beans raised were canned by the same process employed before, but instead of keeping as before they spoiled and some of the cans were found to contain the deadly poison produced by the B. botulinus.

Since the scores of cases of botulinus poisoning from ripe olives canned in glass and from spinach, an investigation has been made of the soil in the vicinity of the canning factories in California from which the infected products came and it has been found to be infected with the botulinus bacillus. The real source of infection is thus clearly seen.

All agricultural authorities warmly advocate animal manure as fertilizer. Doubtless, this method of fertilizing the soil has distinct advantages. However, the dangers which arise from infection of the soil with the pernicious bacteria found in animal manure must be given consideration. It is, indeed, not unreasonable to suggest the advisability of discouraging the use of animal manures for use in vegetable gardening, or at least if such manures are used should they not be first subjected to a process of sterilization which will insure the destruction of the dangerous germs which are always present? That manure is not necessary for the enrichment of the soil is clearly shown by the fact that natural soils are found which are as rich in plant food of the finest sort, as could possibly be desired.

When we are taking such precautions to avoid contamination through drinking water, insisting not only that the water should be pure but also that the individual drinking cup shall be used so as to make certain that the vehicle as well as the water itself is clean; when we are taking care to see that food is protected from flies, that our bread is wrapped in paraffin paper, that milk is pasteurized or "certified" and delivered in aseptic containers; and while we are even taking the precaution to inspect the people who handle foodstuffs in any way, such as grocers, bakers, cooks or waiters; when we take such great pains in so many ways to make sure that our food is kept clean after it is produced, why should we permit it to be produced under conditions which almost absolutely insure contamination with the dirtiest kind of dirt and infection with the most deadly of known germs?

There are many excellent fertilizers besides animal manure and there are well known methods of improving the fertility of the soil without the addition of either manure or artificial fertilizers of any sort. It seems more than likely that the sanitarian of the future will extend his inspection to the soil in which food is grown, thus cutting off at its source one of the most common, most certain and most deadly sources of food contamination.

Water Drinking

The daily loss of water from the body is about four and one-half pints. Ordinary food, as eaten at table, contains water to the extent of about one-half its weight. About 12 ounces of water are produced in the body by the reactions which occur in the processes of digestion, assimilation and dissimilation. To supply the daily loss, at least two to four pints of water should be taken daily in addition to that contained in the food. When food is not eaten, more water is needed. When water is taken in insufficient amount, one result is to diminish the volume of the blood. The effect of this is to lower the blood-pressure. Water-drinking is important as a means of raising the blood-pressure in persons in whom the blood-pressure is too low.

Hunt (Cambridge) has shown that in a hot atmosphere as much as six liters (quarts) of water may be needed to neutralize and carry off the enormous amount of heat produced and absorbed. The body's store of water is mostly in the muscles which give it up when needed but replace it slowly. This stored water should never be drawn upon more than is absolutely necessary.

Certain animals, as the camel, are able to go long periods without drink, but only because they are able to store up large quantities of water. Camels often travel two or three hundred miles with heavy loads, going as long as 15 days without water, and instances are on record in which waterless stretches of more than 600 miles have been covered. After having been deprived of water for several days, the camel readily swallows 40 gallons of water, and its ordinary drink is 7 or 8 gallons. The sheep of the Nebo national forests in Utah pass the four and one-half months of summer without water, according to the U. S. Forest Service, and thrive on the small quantity of moisture found in the scanty herbage which grows in that dry, rocky region. The American prong horned antelope lives contentedly in the desert of the Southwest notwithstanding the absence of water. (Hornaday).

Human beings differ from these desert bred animals in that they require a large amount of water. The water content and daily need of the body depends upon age as well as weight. An infant needs four times as much water as an adult in proportion to its weight. That is, a child weighing thirty-five pounds needs as much water, daily, as an adult weighing 140 pounds. Restriction of water hinders growth and development. Great care should should be taken to supply infants and school children with water at frequent intervals

In some up-to-date business houses the excellent practice has been established of supplying water to each employee six times a day, a capital means of increasing efficiency.

Tests for the Purity of Water.

A critical examination of water with reference to its purity and fitness for use as a beverage or for culinary purposes requires the services of expert chemists and bacteriologists. There are a few tests, however, which are of considerable value and may be employed by a person who has such a knowledge of chemistry as may be obtained in the high school department of the public schools.

The following table (Notter and Firth), gives the method of testing water for some of the most common chemical impurities likely to be found in drinking water:

Reagents Necessary for Qualitative Examination of Water

Substance sought for	Reagents to be used, and effects	Remarks
Reaction	Litmus and turmeric powders; usual red or brown reactions.	Usually neutral. If acid, and acidity disappears on boiling, it is due to carbonic acid. If alkaline, and alkalinity disappears on boiling, to ammonia (rare); if permanently alkaline, to sodium carbonate.
Lime	Oxalate of Ammonium White precipitate.	Six grains per gallon (9 per 100,000) give turbidity; sixteen grains (23 per 100,000) considerable precipitate.
Ammonia	Nessler's solution A yellow color or a yellow brown precipitate.	If in small quantity, several inches in depth of water should be looked down through on a white ground.
Iron	Red and yellow prussiates of potash and dilute HCl Blue color	The red for ferrous and the yellow for ferric salts.

Hydrogen sulphid	A salt of lead Black precipitate	When the water is heated the smell of hydrogen sulphid may be perceptible.
Lead or copper	Ammonium sulphid Dark color, not cleared up by HC1	Place some water (100 c. c.) in a white dish, and stir up with a rod dipped in ammonium sulphid; wait till color produced, then add a drop or two of hydrochloric acid. If the color disappears, it is due to iron; if not, to lead or copper.
Lead	Small crystals of potassium bichromate give a turbidity.	One-tenth grain per gallon gives an immediate turbidity; one-twentieth grain per gallon after one minute; one-fiftieth grain per gallon after half an hour.
Zinc	Render water slightly ammoniacal; boil; filter; a few drops of potassium ferrocyanid give a haze to white precipitate Hydrogen sulphid gives a white precipitate	The filtrate must be quite clear before the ferrocyanid is added. This reaction is not available if iron be present or if the water be acid or alkaline.

Water obtained from uncertain sources should always be boiled; indeed, this precaution is a wise one under nearly all circumstances when traveling.

Very hard water should be boiled for a long time to eliminate, so far as possible, the lime which it contains.

Mineral Waters.

Mineral waters are unwholesome. Their use should be avoided. Saline waters, which are usually taken for their laxative effect, when long used, cause colitis. This was pointed out by Von Noorden and other clinicians some years ago. These waters also disorder the stomach. So-called calybeate waters, supposed to be beneficial to the blood, often contain so little iron that they can produce no appreciable effect unless taken in quantities amounting to some gallons daily. The same is true of waters supposed to be beneficial in certain maladies because of the presence of lithia. The amount of lithia in these waters is so small that one would need to drink a barrelful to get a single medicinal dose. More than this, it has been shown that lithia is absolutely worthless as a remedy for gout and other uric acid disorders for which these waters are recommended; and it is doubtful if mineral iron can replace the organic iron of the blood.

Some bottled waters are valuable and highly to be recommended because of their unusual purity and freedom from minerals. These are not to be classed with mineral waters.

Distilled Water.

Water which has been purified by double distillation and rendered palatable by aeration, is a perfect beverage. Such water is in no respect inferior to water from any natural source, and is absolutely pure and not liable to contamination.

The idea set afloat by an impractical English physician some years ago that distilled water is not only unwholesome but actually dangerous, is wholly without scientific foundation. It is true that the body cells are adapted to a saline medium. The fluids of the body which bathe the cells and tissues contain about four-fifths of one per cent. of salt and other mineral substances. When these cells are exposed to distilled water, they swell up and break into fragments. But Nature has provided against any such catastrophe. When water is taken into the stomach, it always finds there a sufficient amount of saline liquid to give to it a degree of salinity sufficient to protect the body cells from any possible harm. Nature is no bungler.

The use of distilled water or absolutely soft water is not essential to health. No evidence has been offered that moderately hard water, that is, water containing a few grains of lime salts to the gallon, is in any way prejudicial to health. It is barely possible, in fact, that the lime of hard water may under some circumstances render the body some service by supplementing a deficiency of lime in the food.

It has been noted, however, that stones in the bladder and kidney stones are much more common in districts where only very hard water is obtainable than in regions where an abundant supply of soft water is available.

Purification of Water With Chlorin.

Freshly prepared chlorid of lime is added to the water and thoroughly mixed with it in proportion of 5 to 8 pounds of chlorid of lime, or "bleach," to one million gallons of water. When liquid chlorin is used, which is the best practice, only one or two parts per million are used. The residues left in the water when hypochlorite of lime or liquid chlorin is employed are harmless. The chlorid of lime gives to the water a very slight degree of hardness. This is a very practical emergency method which may be applied at once to water known or suspected to be contaminated. Either chlorid of lime or chlorinated soda may be used. The preparation must be fresh.

This method is now used in treating the water supply of many cities, and has in some cases quickly reduced the death rate from typhoid fever to one-fifth the original rate.

The old methods of filtration cannot be relied on as a means of rendering water safe for drinking except as regards animal parasites. Modernly constructed filter beds greatly reduce the number of bacteria, but do not destroy them all. Chlorination is the only safe method, and fortunately is so easily available and so thoroughly efficient and practical that it may be utilized on short notice and under almost any conditions. By the installation of automatic machinery for chlorination, many dangerously polluted public water supplies have been rendered safe, and many typhoid epidemics have been promptly arrested.

It is well for travelers to carry with them a supply of freshly made chlorid of lime (not calcium chlorid) for use when water is not known to be pure. One grain in a quart of water will in a few minutes destroy all bacteria that may be present. This quantity is, in fact, sufficient to sterilize three gallons of water in half an hour. It is a good plan to put a grain of the chlorin salt into the water bottle whenever it is filled so as to make sure of a supply of pure water whenever needed.

A somewhat stronger solution, say ten grains to the quart, may be used for disinfecting fruits and other raw foods.

MEDICAL DIETETICS

Regulation of the diet is perhaps the most important of any single measure in the treatment of chronic disease. As Professor Chittenden, the eminent head of the Sheffield Scientific School, has well said, "It is one of the axioms of physiology that the majority of the diseases of mankind are due to, or connected with, perversions of nutrition." Food supplies the materials necessary for the repair of the body cells; food furnishes the materials upon which the body cells work in their various activities, and food also acts as a vital stimulus to the cells. By regulating the food supply in kind and in amount, and by modifying its form, every tissue and function may be profoundly influenced.

It is important to remember that a large part of our daily diet is comparatively new to the human stomach. The development of the art of cookery has led to the use of many substances with which the primitive stomach was wholly unacquainted, and has introduced into the dietary a great number of artificial foods, many of which are by the processes of preparation more or less modified. Man no longer takes his sustenance from the hand of Nature, gathering it, often at the cost of much physical exertion, from forest and plain, hillside and valley, but receives it at his door from the hands of the grocer, the butcher, the miller, the baker and a hundred other purveyors of food and culinary accessories. Instead of taking our food supply in the natural state in which it is furnished to us by Mother Earth, or made more acceptable by simple cooking processes, we require it to be sophisticated and in a multitude of ways denatured and even poisoned by an army of caterers, cooks, confectioners and food adulterators, thus exposing our bodies to an indefinite number of damaging influences which our primitive ancestors escaped.

Clinical experience has demonstrated that a large share of all chronic disorders to which civilized man is subject are the result of erroneous habits of life, and there can be no question that wrong eating habits are, of all our habitual errors, most active in the production of the disorders of nutrition which characterize all forms of chronic disease. It is evident, then, that in dealing with these disorders, the first thing to be done is to correct errors in nutrition by so regulating the dietary as to eliminate faulty habits, cultivate normal or biologic appetites and train the digestive organs to normal activity.

Among the illustrious examples of the benefits arising from such a correction of faulty dietetic habits may be mentioned the case of Professor Huxley, who, after describing himself as suffering from want of energy and "life-long depression," by renouncing the use of alcohol and tobacco and greatly lessening his intake of food, freeing himself, as he said, "from gross intemperance," recovered his former vigor and enjoyed as good health as ever in his life.

Until very recent years, almost nothing was known about the therapeutics of diet. The whole subject, like most other medical matters was based on empiricism. Today, thanks to the labors of Pavlov, Rubner, Voit and Pettenkofer, Bayliss, Atwater, Benedict, Chittenden, Osborne, Mendel, Cannon, Hertz, Case, McCollum, and scores of other modern investigators, we have a really scientific basis for dietetics; and as a result such wonderful victories in the battle against disease are daily being won as a century ago would have been regarded as truly miraculous. Indeed, the old materia medica of the last generation is rapidly falling into "innocuous desuetude," having been supplanted by a rational and efficient system of *materia alimentaria.*

The purpose of this section of this work is to make practical application to individual diseases and diseased conditions of the scientific facts which have been presented in the foregoing pages. If the reader misses many of the familiar formulas usually found in works on medical dietetics, let him not be disconcerted and imagine himself on untried ground; but rather, let him be assured that every suggestion or recommendation has behind it not only a sound physiological fact, but also long and thorough practical tests at the Battle Creek Sanitarium, where many thousands of intelligent men and women are annually fed in harmony with the principles herein set forth. The same methods are likewise in extensive use in a more or less complete form in many other sanitariums and hospitals which are served by dietitians trained in the Battle Creek Sanitarium School of Home Economics, from which hundreds of expert dietitians have gone out to teach and practice the principles of "biologic" living and scientific dietetics.

Before considering the dietetic treatment of individual diseases we shall first give attention to some general considerations which apply to nearly all disorders, especially the question of intestinal toxemia or autointoxication, common errors in diet, and some of the more important tests for the functions of digestion, nutrition, metabolism and excretion, by means of which the regulation of the dietary may be scientifically directed.

ERRORS IN DIET

The many forms of indigestion, as well as most of the disorders of nutrition, are due to errors in diet. Attention has already been called in the preceding chapters to numerous common faults and erroneous notions in relation to human feeding, but it will perhaps be profitable again to briefly summarize those errors in diet which are most common and the correction of which is highly essential in the treatment of nutritive disorders.

Overeating.

An excessive intake of food is much more common than a deficiency. The average person has little appreciation of the fact that there is no definite relation between the bulk and weight of food and its nutritive value. For example, a pound of almonds has more food value than 20 pounds of cabbage, cauliflower or eggplant, or 15 pounds of beets, carrots, or string beans.

So it is possible for one to overeat by unduly distending the stomach with bulky food, such as coarse vegetables or juicy fruits, while the quantity of nutriment absorbed may really be insufficient to nourish the body. On the other hand, one may easily take a great excess of nourishment, although the actual weight and bulk of the food consumed may be small.

On this account it is highly important that every one should learn how to estimate the actual values of foodstuffs as expressed in calories. This may be easily done by a careful study of the extensive tables presented elsewhere in this work.

The general bad effects of overeating are an excessive gain in weight, dullness after meals, drowsiness, insomnia, indigestion. It is to be noted, also, that over-fed people are more likely to suffer from cancer than the underfed. According to Williams, cancer is almost unknown among the poorly fed Hebrews of East London, but is very common among the wealthy Jewish bankers of Hyde Park. Bright's disease, arteriosclerosis, high blood-pressure, and apoplexy are also among the consequences of overfeeding. In time, the stomach breaks down from overwork; flatulence, hyperacidity, disorders of the liver and gallbladder and hemorrhoids, are among the common results.

It is always to be remembered that what would be only a sufficiency or even not enough for a hard working laborer, might easily be a great excess for a man of sedentary habits. The daily ration for persons of different occupations has been considered in a previous chapter.

The method of serving the food in successive courses, and especially the plan of arranging the bill of fare in such a way as to encourage eating to excess by presenting the most highly palatable dishes last, is productive of great mischief. Desserts consisting of rich dishes, such as ice cream, pastry and confectionery, are on this account to be condemned. Persons who are addicted to overeating should adopt the plan of eating at the beginning of the meal a considerable quantity of bulky food, such as spinach, cabbage, turnips, carrots, lettuce, etc. By this means, the sense of satiety may be induced before an excess of nourishment has been swallowed.

Special injuries may result from an excess of particular food principles: for example, an excess of fat leads rapidly to obesity and induces so-called "biliousness" by causing too long retention of foodstuffs in the stomach and of food residues in the colon, thus promoting intestinal putrefactions. Intestinal toxemia induced in this way is the explanation of the injury suffered from eating an excess of fat, rather than "clogging" of the liver, the popular explanation.

Persons whose stomachs do not produce a sufficient quantity of gastric juice and those suffering from intestinal toxemia, the result of chronic constipation, should especially avoid an excess of fat. The oil enema, sometimes employed for the relief of constipation, may do harm by promoting intestinal putrefaction and by interfering with gastric digestion. On this account, paraffin oil should be used for this purpose rather than olive or linseed oil, for the reason that it is non-absorbable, has no effect upon the digestive processes, and does not undergo either fermentation or putrefaction.

Less injury, perhaps, is likely to follow from an excessive intake of starch than from any other quantitative error in diet, as it taxes the digestive process less than any other food principle and produces less disturbance of metabolism. This cannot be said, however, of the carbohydrate, sugar, the reverse being true, especially in relation to cane sugar, the excessive use of which not only induces disorders of digestion, particularly hyperacidity, but is very probably one of the chief causes of diabetes, as well as of chronic gastric catarrh. The free use of cane sugar also leads to lime starvation, as elsewhere explained. Malt sugar is much less likely to produce gastric or nutritive disturbances; and the free use of milk sugar, because of its slow absorption, may become a valuable means of changing the flora by promoting the growth of acid-forming organisms in the colon.

Eating an excess of protein is one of the most grievous of all dietary faults. It may be rightfully regarded as one of the leading causes of chronic disease, through the intestinal toxemia which results from the putrefaction of undigested residues of meat and other proteins in the colon and the absorption of indol, phenol and other putrefaction products. Bright's disease, rheumatism, cancer, gastric ulcer, skin disorders, neurasthenia, insomnia, and a long list of chronic disorders directly or indirectly due to intestinal toxemia, are among the evil results of a high protein diet.

The researches of Rubner, Chittenden, Sherman, Folin and others supply a scientific basis for the view that one calory of protein for each pound of normal body weight is sufficient to supply all the nutritive needs of the average individual. This amount of protein will be well supplied by a pint or even by half a pint of milk, according to the size of the individual, even though eggs as well as meat are excluded from the dietary. A few ounces daily of soy beans, almonds or other nuts will also fully meet the demand. If meats are discarded from the bill of fare, and eggs and milk are used in moderation, the ordinary mixed diet will usually furnish a proper balance of protein.

Injury may result, as shown by Bunge and as pointed out elsewhere in this work, by making the bill of fare consist too largely of cereals, such as are supplied by ordinary breakfast foods. Cereals introduce into the body an excess of mineral acids, and when used in excess, may lead to a preponderance of acids in the body, inducing a mild form of acidosis, with lowered vital resistance and impaired nutrition. If the cereal intake of the average individual were reduced one-half by substituting an equivalent amount of farinaceous material in the form of potatoes and other vegetables, the results would be a great improvement in our national health. Potatoes are rich in alkaline salts, which neutralize the excess of acid found in cereals as well as those produced by the cell activity of the body. These useful salts are also found in fruits. The preponderance of acids found in meats is four times as great as that found in cereals, hence the injury from a heavy meat diet is so much the greater.

Underfeeding.

Underfeeding is most frequently observed among the women and children of the poorer classes. Invalids, also, through lack of appetite or ignorance of food values, frequently suffer from lack of nourishment. An adult person of average size who is taking less than 1,800 calories daily is almost certain to be underfed, unless confined to bed.

Underfeeding is naturally accompanied by a loss in weight, the degree of which is a fairly accurate means of determining the measure of the food deficiency. The underfed individual also suffers, often to a very extreme degree, from a deficiency of vitamins. Famine is almost universally accompanied by scurvy and other deficiency disorders.

Modern studies of metabolism have shown that at least two or three ounces of carbohydrates (starch and sugar) must be taken daily to insure the proper utilization of other foodstuffs and to prevent acidosis. A normal dietary contains six or eight times this amount of carbohydrates.

The amount of protein eaten is rarely too small, although a dietary of exclusively vegetable origin may easily be deficient in complete proteins unless very carefully selected. The addition to a dietary of ordinary cereals or other vegetable foodstuffs of four to eight ounces of milk will insure an ample amount of complete proteins to meet the needs of the body.

Deficiency Diet.

Bills of fare notably lacking in vitamins are very commonly found in prisons, almshouses, hospitals for the insane and feeble-minded, college dormitories and boarding-houses, also in many private homes. A breakfast consisting of toast and coffee, bacon, griddle cakes and syrup, a very common menu, is almost altogether lacking not only in vitamins but in iron, lime and cellulose—elements highly essential to a complete dietary. Canned foods, particularly canned meats and vegetables, as well as dried fruits, are likely to be deficient in vitamins. Canned tomatoes and canned fruits are processed at a sufficiently low temperature largely to prevent the destruction of the vitamins, which are also preserved to a notable extent by fruit acids.

Reducing diets, such as are recommended for combating obesity, are almost always deficient in vitamins. Reduction in the amount of food eaten necessarily reduces the vitamins, along with the other food constituents; and because of it, many persons on a special fat-reducing regimen have been greatly injured by the lack of these food essentials. A reducing diet should always comprise an abundance of foods rich in vitamins. The lack of this important food principle in the so-called "light diet" of hospital wards and the ordinary fever diets in common use has no doubt been responsible for delayed convalescence and various untoward symptoms and disappointing failures in thousands of cases in hospital and private medical practice.

Irregular Meals.

Irregularity in the times of eating is highly injurious for numerous reasons which become at once apparent when one recalls some of the simple facts relating to the physiology of gastric digestion. The stomach empties itself normally in about four hours. When an interval of five hours is allowed between meals, it has an hour in which to completely empty and disinfect itself, as well as to recruit the energies of its gland cells in preparation for the work of digesting the next meal. This is essential for good digestion.

There is a close relation between the taking of food and the normal rhythmic activity of the colon. During the taking of a meal the food residues are moved forward in the colon four times as far as during the hour preceding the meal. When a meal is omitted, this physiologic stimulation of the colon is lacking, and the result may be the failure of the colon to evacuate its contents at the normal time, leading to distention of the colon and stasis or stagnation, which may become the starting-point for chronic constipation. Thus regularity of meals is necessary in order to secure normal rhythmical action of the colon in the evacuation of food residues and other body wastes.

When the interval between meals is shortened, which is likely to occur when meals are taken at irregular hours, the result will be the reception of fresh food into the stomach before the digestion of the previous meal is completed. This deprives the stomach of rest and so prolongs the stay of the digesting foodstuffs in the stomach as to produce not only exhaustion of the organ but undue congestion of the gastric mucous membrane from too long contact with the gastric juice and digesting foodstuffs. The ultimate result will be gastric catarrh, slow digestion, together with other disorders affecting the later stages of digestion.

Late suppers are particularly injurious. They not only lead to impaired sleep, but take away the appetite for breakfast the next morning because the stomach is exhausted. Thus it is very common for the late diner to suffer from heaviness, headache and a feeling of malaise and inefficiency the next morning.

The heavy meal usually eaten at night by city dwellers is, in the writer's opinion, chiefly responsible for the obstinate insomnia so frequently encountered, especially among persons active in business or society.

Hasty Eating.

Insufficient mastication is a fault which has become almost universal because of the general use by civilized people of foods which by cooking have been rendered soft or semi-liquid, and hence receive little or no chewing to prepare them for swallowing.

All foods, whether solid or liquid, should be chewed, and it is important to take at each meal a sufficient amount of dry, hard food, not only to exercise the teeth but to stimulate the salivary glands to produce an adequate amount of saliva, which when thoroughly mixed with the food by mastication, renders material aid in its digestion.

Burton says in his "Anatomy of Melancholy:"

"Crato adviseth his patient to eat but twice a day, and that at his set meals . . . and to put seven hours' difference between dinner and supper. Which rule, if we did observe in our colleges, it would be much better for our healths, but custom, that tyrant, so prevails that, contrary to all good order and rules of physic, we scarce admit of five. Moreover, that which he doth eat must be well chewed, and not hastily gobbled, and by all means to eat no more than he can well digest."

Crato's advice to put seven hours between the meals may be advantageously followed by many sufferers from gastric disorders. Some stomachs need even more time for rest and clearance.

Drinking at Meals.

The general custom of drinking several glasses of water or several cups of tea or coffee or other beverages with meals is a common cause of indigestion. One glassful of water or other liquid at a meal is quite sufficient to supply all dietary needs. Water-drinking does not interfere with digestion by diluting the gastric juice, but by overstimulating the glands of the stomach, causing them to produce an excess of gastric acid.

Bad Food Combinations.

Much stress was formerly laid upon the making of proper combinations of foods. The mixing of fruits with vegetables and of acids with milk were particularly considered to be highly productive of indigestion. Later experience, however, has shown that while some attention should be given to food combinations, there is comparatively little ground for anxiety upon this point, provided the foodstuffs eaten are wholesome in character and are thoroughly masticated. Wholesome foods harmonize with one another in the liquid state or when reduced to a smooth pulp by thorough chewing. It is, of course, essential that the foodstuffs which enter into a menu should be selected so as to secure a balanced bill of fare; that is, one would not combine eggs with beans because both are rich in protein, or olive oil with nuts for the reason that nuts are rich in fat. Neither is there any occasion for the addition of sugar to oatmeal and other breakfast cereals, or syrup to griddle cakes, for the reason that these foodstuffs consist chiefly of starch, which by the process of digestion is all converted into sugar. Cream or milk and fats are the proper accessories for cereal foodstuffs, rather than sugar, the free use of which with breakfast foods is a very common cause of indigestion.

There are, however, certain unphysiologic combinations which should be noted, such as the absurd practice of adding cane sugar to cereals, drinking freely with liquid foods, the addition of cream to pastry. Meat and milk is an objectionable combination, first, because both are highly nitrogenous foods and because the highly acid gastric juice evoked by meats, produce hard, indigestible curds which remain long in the stomach.

Highly Seasoned Foods.

Foods which are highly seasoned are overstimulating to the appetite and lead not only to overeating but to overstimulation of the digestive organs, the result of which is hyperacidity, which is later followed by degeneration of the secreting glands and a deficiency of gastric acid. Gourmands are certain to suffer sooner or later from their gastronomic abuses, being especially subject to gastric ulcer and cancer.

The Use of Condiments.

Mustard, pepper, pepper-sauce, horse-radish, cayenne, capsicum and other hot and irritating substances have no proper place in the bill of fare. These substances all owe their properties to highly poisonous essential oils which in the pure state readily raise blisters upon the skin, and when taken internally produce irritation of the delicate structures with which they come in contact. Though certain condiments may at first stimulate the stomach to increased activity, the ultimate result of their use is lessened gastric activity and irreparable injury to the stomach, liver, kidneys and other vital organs, including the heart and blood vessels.

Insipid Foods.

Foods which are lacking in flavor, while much less positively injurious to the body than those which are highly seasoned, are nevertheless objectionable, for the reason that they are deficient in the flavoring substances which Nature places in normal foods to render them attractive to the palate, and which through the nerves of taste call forth the glandular and other activities concerned in the process of digestion. To be well digested, food must be attractive. It should please not only the sense of taste but the sense of smell and the sense of sight. This has been clearly shown by the classical experiments of Pavlov.

A Monotonous Diet.

A monotonous diet is objectionable, not simply because it fails to gratify the sense of taste, but because it is likely to be deficient in some of the elements essential to good nutrition. To make sure that the body is abundantly supplied with all the subtle principles which it needs to repair its tissues and sustain its varied activities, a considerable variety in the bill of fare is required. The number of kinds taken at any one meal should not be too great, but they should be varied from day to day.

Indigestible Foods.

Such indigestibles as pickles, green olives, rich pastry, preserves and fried foods present to the digestive organs a difficult or even impossible task, since they remain long in the stomach, irritating its walls and exhausting its secreting glands and sometimes causing injury through mechanical irritation.

Cold Foods.

Very cold foods, such as ices, ice cream, and ice water, are questionable as elements of a meal, but if taken at all, should be in limited quantity, and so slowly swallowed that they will acquire a temperature near that of the body before reaching the stomach.

Hot Foods.

Very hot foods are objectionable for the reason that excessive heat produces the same injurious effects upon the mucous membrane of the stomach as upon the skin. The mucous membrane, in fact, appears to be less able to endure high temperatures than the skin, being more delicate in structure and less accustomed to such contacts. The use of hot food is an unnatural habit. and one which is without doubt more or less detrimental to the health. Dr. William Mayo, the eminent surgeon, has for years maintained that the taking of hot foods and liquids into the stomach is a cause of gastric cancer.

Eating When Exhausted.

When the nerves or muscles are in a state of exhaustion as the result of effort, all the bodily activities are slowed down. The taking of a hearty meal under such conditions is often attended by bad results. Digestion fails for lack of a sufficient amount of active gastric juice, and acute indigestion is a frequent consequence. Rest, especially sleep, is indicated rather than food, unless the exhausted person has been fasting for some time. In such cases the most suitable nourishment will be found in a solution of honey or malt sugar in water or diluted fruit juice. Nutriment of this sort is quickly absorbed and immediately appropriated, requiring little or no action of the digestive organs. An exhausted person, after resting for an hour or two, may take simple food in liberal quantity. Eating heartily when one is tired out by either mental or muscular effort is likely to be followed by indigestion, malaise, and incapacity for work.

Misinformation and Pseudo-Scientific Teaching.

The popular newspaper and magazine literature of the day are filled with dangerous misinformation about diet and other matters pertaining to health. Articles by a chemist, of Philadelphia, claiming to be based upon scientific experiments, have been particularly misleading. This writer would have us believe that he has demonstrated, that bolting meat is harmless, that drinking freely of water at meals aids digestion instead of hindering it, and that drinking of large quantities of ice water at meals does not involve risk of indigestion.

The experimenter draws his conclusions from the fact that he was able to subject the stomachs of healthy men to these various abuses without immediate apparent injury. This is the same old argument with which we are so familiar. It has been brought forward in support of liquor drinking and tobacco-using, the tea and coffee habit, the breathing of bad air, neglect of exercise, neglect to breathe properly, neglect of the bowels, and any number of other unhygienic practices that might be mentioned. Within a week of this writing the writer received a letter from a man who maintained that infrequent movement of the bowels is conducive to health, and offered as proof the fact that he enjoys good health, though moving his bowels but once in two weeks.

The professor's experiments simply demonstrate how much abuse a healthy stomach is able to endure before it surrenders to disease. Fortunately, we are all born with a certain margin of safety. The first violations of biologic law may not give rise to any tangible ill effects; the bodily functions are performed as usual. The individual therefore thinks himself invulnerable, perhaps priding himself upon the fact that he can do with impunity things which are considered harmful. He is unaware of the fact that a hidden damage is being done, the effects of which may be irreparable. His margin of safety is being consumed and when it is wholly exhausted, he will begin to realize the harm which has been done; but it will then probably be too late to repair the injury.

Because it seems to make very little difference to a healthy stomach whether bread is stale, and hence quickly digested, or new and slowly digested, it cannot be assumed that it makes no difference to any stomach. The new bread, which only causes the healthy stomach to empty a little more slowly, when taken into a stomach which always empties slowly, even when supplied with the very best of food, may upset the stomach altogether and enormously lengthen the time required for digestion. This principle applies to all sorts of unhygienic practices. Infractions of the laws of good digestion which are apparently followed by no ill effects whatever in healthy persons make the difference between comfort and discomfort, good digestion and no digestion at all, in persons whose digestive powers are impaired.

It is true that husky lumberjacks "bolt their three square meals each day," along with (until very recently) a lot of bad whiskey, besides doing many other equally unwholesome things. But it must not be imagined that even the lumberjack can go on doing this forever with "immunity" from stomach and other troubles. Some of the worst cases of gastric disorder the writer has ever encountered were those of men who had spent a few years of their lives in lumber camps and whose stomachs had been subjected to the sort of treatment described by our professor as innocent. Cancer, gastritis, ulcer of the stomach, and other gastric disorders, are common among these men, notwithstanding the great advantages which they derive from their out-of-door life and vigorous bodily exercise, which should give them supreme health and high resistance.

Professor Pavlov showed that taking a quantity of water into the stomach gives rise to the production of an increased amount of gastric acid. The increase is not so great as to cause any serious disturbance in a healthy stomach, but in the case of a stomach which is already making an excess of gastric acid, the drinking of a quantity of water may be the means of greatly increasing the difficulty. Thus it is an easy inference that the habitual use of liberal quantities of water in connection with meals, like other gastric stimulants, will in time produce pronounced hyperacidity.

A glass of water at meal times is not at all harmful for the ordinary person, but the practice of drinking water to wash the food down is very injurious. Those whose stomachs are already producing an excess of acid, however, should avoid all water drinking at meals as well as the use of broths and thin soups.

In the feeding of milk to many hundreds of patients subjected to the milk regimen, experience has shown the taking of milk slowly to be so important that the patient is invariably required to draw it through a straw or a small glass tube. In this way a person may take as much as six quarts of milk a day without difficulty.

A unity of function characterizes the whole alimentary tract. All the various processes of digestion are linked together. When food is taken into the mouth and the muscles of mastication begin to work, activity begins all along the alimentary canal. While the food is being sipped or chewed, the food residues in the colon move forward toward the exit four times as rapidly as at other times. Consequently, sipping, chewing, and tasting the food are most important natural means of encouraging efficient bowel action. An infant or young animal always sips its food with a sucking movement. This is important for the reason that the suction force exerted on the salivary glands increases the flow of saliva. This is easily demonstrated by experiment.

INTESTINAL TOXEMIA—AUTOINTOXICATION

Miller, of Berlin, made an exhaustive study of the microbes of the mouth and showed the dominant role which they play in caries of the teeth and various other diseases of the teeth and gums. When the author, some twenty-seven years ago, established a laboratory for the study of the bacteria of the stomach with the expert assistance of Professor Novy, of the University of Michigan, it was generally believed that bacteria were always present in the stomach, since it was known that they existed in the mouth and were swallowed in great numbers with the food. These studies were begun by giving a sterile test meal to healthy persons, great care being taken to avoid accidental contamination by thorough cleansing of the mouth and the use of sterilized stomach tubes. The expectation was that many bacteria would be found, and it was intended to make a study of these, which might be termed the normal bacteria, for subsequent comparison with the bacteria in pathological cases. After ten days' work, during which time a considerable number of cultures were made, no bacteria at all had been found. Various culture mediums had been employed and the conditions essential for encouraging the growth of anaerobic as well as aerobic species had been supplied, but without result. The character of the test meal was then changed. It was no longer made sterile as before, and the result was that some of the cultures showed growths, although the majority of them still remained sterile.

As far as the writer knows, this was the first demonstration of the fact that the healthy stomach carries on its work without the aid of bacteria, and that it is even capable of sterilizing non-sterile food substances which may be introduced into it. Since then, more than twenty thousand bacteriological examinations of stomach fluids have been made in the clinical laboratory of which the writer has charge. Of these, the great majority have been found sterile. Numerous other investigators have obtained similar results, and it may be considered as now thoroughly established that the healthy stomach carries on its work without the aid of bacteria, and that their presence in the stomach fluid obtained after a test meal is an evidence of the presence of a pathological state. Normal gastric juice destroys bacteria, or at least inhibits their growth, so that the process of gastric digestion is carried on without the aid of microbic activity. When the gastric secretion becomes deteriorated in character so that it no longer destroys bacteria or inhibits their growth, various pathologic processes are set up in the stomach, which extend to the intestine and to the liver and other adjacent organs, resulting in serious derangement not only of the digestive functions but of the system at large.

Later the study of the bacteria of the small intestine occupied the attention of bacteriologists. Roux, a pupil of Pasteur, showed the fallacy of his master's contention that microbic intervention is necessary for the maintenance of plant life, by causing beans to grow in a thoroughly sterile medium. Nuttall and Thierfelder showed that guinea pigs brought into the world aseptically by Caesarian operation lived when fed upon sterilized food, although they did not grow so rapidly as the control animals. Experiments made upon chickens and other animals indicated that animals fed upon sterilized food did not thrive so well as those fed upon ordinary food. Subsequent researches have made it clear that the reason animals fed upon sterilized food do not thrive so well as those fed upon the ordinary unsterilized diet is not on account of their being deprived of the beneficent influence of microbes but because the vitamins of the food have been impaired or destroyed.

Dr. Levin, of Stockholm, accompanied the Natthorst expedition to the Arctic regions in the summer of 1898 for the purpose of studying the bacteria of that region. He passed through his apparatus in obtaining each specimen, 20,000 liters (more than 5,000 gallons) of air. He found practically no bacteria in the air. In sea water, snow, and melted ice he found on an average one organism in a little more than one-third of an ounce. In twelve samples of brown mud he found only a single microbe. The intestinal contents of the polar bears, seals, eider ducks and other birds, as well as sharks, sea urchins, sea anemones and crabs, were nearly always sterile. His examinations were made both by culture and by staining, so as to exclude the presence of dead bacteria. These results agree with those of Nencki and also Nuttall and Thierfelder, whose experiments showed that animals are able to live without the presence of bacteria in their intestines.

The fact that only a minority of these animals show bacteria in the intestines clearly indicates that their presence in any part of the alimentary canal is due to accidental infection and is not essential to the well-being of the animal organism.

Conclusive as are the observations of Levin in the Arctic regions as indicating beyond the shadow of a doubt that microbes are not essential to the most vigorous animal life, we may still call attention to the exhaustive researches of Adami, who studied the intestinal contents of different parts of the intestinal tract from the stomach to the rectum, and found the contents of the duodenum and the upper part of the small intestine to be practically sterile. In fact, in healthy conditions the entire small intestine was found free from bacterial development, with the exception of harmless lactic-acid-forming organisms. Bacteria capable of producing putrefaction were found only in the large intestine or at the extreme lower part of the small intestine. In pathological conditions, however, the putrefactive bacteria which ordinarily exist only in the large intestine are found higher up, in the small intestine, in some cases occupying the entire intestine and even the stomach and biliary passages. This general infection of the intestine exists in both acute and chronic gastroenteritis and in various other pathological conditions of the stomach and intestine.

Escherich has made an interesting study of the bacteria of the intestine in infants. These observations show the intestinal contents of an unborn child to be absolutely sterile. Within eight or ten hours after birth the bacillus *bifidus* and other lactic-acid-forming bacteria make their appearance. So long as the nourishment of the child consists exclusively of mother's milk, the intestine is occupied only by acid-forming bacteria, the stools are free from putrescence, no indol is found in the urine, and there is no evidence of the slightest putrefaction in any part of the intestine. When fed upon cow's milk, however, the intestine often becomes infected and the stools offensive, and bacteriological examination shows the presence of the putrefactive organisms which are always found in market milk. Tissier, of the Pasteur Institute, has confirmed and extended these observations.

Later studies have shown that while in early infancy the bacillus *bifidus* is the dominant organism and protects the colon from the invasion of putrefactive bacteria, another, stronger growing acid-forming bacillus, the *B. Acidophilus,* makes its appearance as the child advances in age, and this organism, if encouraged by a biologic, or non-putrefactive diet and proper care of the colon, is capable of preventing the putrefaction of the body wastes and food residues in the colon, thus protecting the body against the numberless evils which result from the absorption of putrefactive products from the colon, the chief cause of intestinal toxemia or autointoxication. The loss of this most important defense against disease is one of the greatest misfortunes a human being can suffer, and yet there are few among civilized people who do not undergo life-long injury from this cause. The maintenance of normal intestinal flora is one of the chief essentials of a biologic life; and the restoration of the normal flora by securing the dominance of the *B. Acidophilus* in the colon, is one of the chief objectives in the rational dietetics the principles of which we have undertaken to set forth in this work.

Bouchard was one of the first to call attention to the rôle played by bacteria in the production of toxins in the body, resulting in a condition which he termed autointoxication. He showed by experiments on rabbits that solutions of fecal matter were highly toxic in character and that the toxicity was increased in proportion to the degree of putrefaction. Thus, the fecal matters of a meat-eating animal or a meat-eating man were shown to be twice or more as toxic as the feces of a non-flesh-eating man or animal. Bouchard estimated that in some cases half the entire bulk of the feces consisted of bacteria.

Charrin of Paris, Combe of Lausanne, Tissier, Escherich and numerous other European bacteriologists, as well as Herter in this country, have made exhaustive studies of the different species of bacteria which are produced in the intestine and of the toxins which they generate and the effects they produce upon animal organisms. An enormous number of facts of the highest importance have been developed by these indefatigable investigators, which leave no shadow of doubt that the putrefactive bacteria and anaerobic organisms of various sorts which thrive in the colon and the lower part of the small intestine are a constant and almost universal source of mischief to the human race, and that many chronic and acute maladies and various degenerations owe their origin to this cause.

In his excellent work, "*Autointoxication,*" Combe gives an admirable summary of the facts known in relation to the toxins of intestinal origin due to bacterial growth. The prolific growth of bacteria in the intestine is due to the fact that the conditions of warmth and moisture are such as in the highest degree to promote bacterial development. The absence of air in the lower part of the intestine adds another important factor which favors the development of the various classes of bacteria which give rise to putrefaction. A considerable amount of air is present in the upper part of the intestine, for the reason that the air swallowed with the food and drink is absorbed slowly and only disappears entirely when the lower part of the small intestine is reached. The colon is a culture chamber which offers especially favorable conditions for the development of putrefactive organisms and pathogenic bacteria in general.

Herter, as well as others, has shown that the number of these pernicious toxin-producing organisms present depend largely upon the character of the food—the larger the amount of protein food, the larger the number of organisms. The feces of the lion, tiger, wolf and cat show enormous numbers of these pathogenic organisms, while the fecal matters of the buffalo, goat, camel and elephant were found practically free from virulent organisms. In other words, Herter showed that there is a distinct herbivorous type of bacterial flora. When the feces were inoculated into broth, he found mercaptan was produced by the feces of carnivorous animals, but that none resulted from the feces of herbivorous animals. Emulsions of carnivorous feces inoculated into guinea-pigs gave rise to edema, hemorrhages and destruction of tissue. Gas and butyric acid were formed. None of these pathological effects were produced by the feces of herbivora.

An interesting clinical fact in harmony with the above observation was mentioned by Herter; namely, that carnivorous animals frequently suffer from pernicious anemia and other forms of anemia, while these diseases very rarely occur in herbivorous animals unless associated with intestinal parasites.

Langer has shown that in breast-fed infants the colon bacillus develops feebly, while in older persons it grows with vigor. This would seem to indicate that the bacillus becomes more virulent in time or that the infant intestine is a less favorable habitat than that of the adult. By means of a biologic diet, the adult colon may be rendered as inhospitable a place for the mischievous colon bacillus as is that of the normal nursing infant.

Another interesting fact to which Herter calls attention is that in the feces of healthy young persons disease-producing bacteria are comparatively few in number, and that there is a close relationship between the decrease of vital resistance incident to advanced age and the increase of putrefactive bacteria and their products found in aged people.

Of the three great food principles which constitute the digestible portions of our foods, carbohydrates, are chief in importance in relation to the bacteriology of the intestine. No matter how favorable other conditions may be, bacterial growth cannot take place without a food supply. Carbohydrates, that is, starch, sugar and dextrin, constitute the natural and necessary food supply for acid-forming bacteria, the harmless character of which has already been referred to. The lactose, or milk sugar, of the nursing infant's food supply thus encourages the growth of the acid-forming organisms which are found present within a few hours after birth and which, as Escherich has shown, are a protection against the harmful putrefactive organisms which appear later. The proteins, on the other hand, are the natural and necessary food supply for the putrefactive and pathogenic poison-forming organisms which grow in the lower part of the intestine, where the absence of air and the presence of retained and undigested and unabsorbed protein substances furnish conditions in the highest degree favorable for the development of this class of organisms.

The classical experiments of Fischer have shown us that the process of digestion of proteins reduces these complex compounds to simple crystalline bodies (amino-acids) which, when absorbed by the intestinal mucous membrane, are reconstructed into a new albumin molecule—human albumin, as it has been called. Putrefactive bacteria are likewise capable of breaking up the albumin molecule, and produce the very same amino acids, fatty bodies and other substances as do the digestive fluids of the stomach and the intestines. But the putrefactive bacteria do not stop with the formation of these useful products, which at least resemble those formed in animal digestion, but go farther, breaking up the crystalline substances which the body uses in building up its own kind of albumin, converting them into substances of a highly toxic character.

Poisons Produced by Putrefactions in the Colon.

According to Nencki, MacFayden and other investigators, not less than one-seventh of the total amount of protein eaten is ordinarily destroyed by putrefaction, thus occasioning a very considerable loss to the body. But this loss is a matter of small consequence compared with the mischiefs which result from the poisons into which this one-seventh of the nitrogenous food supply is converted, instead of being transformed into human albumin adapted to the nourishment and repair of the tissues. Among the first substances produced by bacteriological action through the breaking up of the crystalline products of normal digestion are the so-called aromatic bodies. From the normal tyrosin is formed cresol and phenol, while from tryptophan are formed the well-known malodorous skatol, indol and pyrrhol, to which the characteristic odors of putrid feces are due.

Of the various ptomaines which are formed the best known are putrescin, cadaverin, parolin, puridin and collidin. These ptomaines have been found in the stools of persons subsisting upon an ordinary mixed diet by Roos, Garcia, Baumann and others.

Bouchard, more than thirty years ago, showed the enormous difference which may exist in the character of the fecal matters. In one case he found a sufficient amount of toxic material in the extract obtained from seventeen grams (less than two-thirds of an ounce) of fecal matters to kill a rabbit weighing one kilogram (two and one-fifth pounds). After changing the intestinal flora, the extract of 200 grams, or twelve times as much of fecal matters, was required to kill an animal weighing one kilogram.

That these ptomaines are not only present in the intestinal contents but that they are absorbed and circulated throughout the body and thus brought in contact with all the tissues is clearly shown by the fact that they have been recovered from the urine. Numerous observers have found cadaverin, putrescin and other ptomaines in the urine of subjects in various forms of disease. Salkowski found indol and phenol in the urine of starving dogs. Observations of Muller made on the faster, Cetti, found both indol and phenol. It was observed that the phenol increased after the fifth day. Indol was also found in the urine of the faster, Succi, and the professional faster, Breithaupt. Ernst and others have shown that in these cases phenol, indol and skatol are formed by the putrefaction of bile, the pancreatic juice and the intestinal juice. According to Muller, the putrefactive activity of bacteria is increased during starvation because of the absence of lactic acid in the intestinal contents and the frequent occurrence of hemorrhages. The stools of new-born infants contain none of these poisons, for the reason that putrefaction has not as yet begun in the sterile intestine of the new-born, although it is true that they may be found in small amount in the urine of a new-born infant, having been derived from the blood of the mother through the placenta. The pancreatic juice seems to be particularly prone to putrefaction. The intestinal mucus also putrifies readily, and the coloring matters of the bile are decomposed by bacteria, by which they are converted into toxic substances.

Phenol (carbolic acid) appears to be formed only in the large intestine. At least this is the opinion held by the majority of authorities. It appears in the urine whenever stasis of the colon occurs, sometimes in cases of obstruction increasing to as much as seventy times the ordinary amount. *Brenzcatechin, hydrochinon* and *alcapton* are three curious coloring matters of a toxic character which are formed by the putrefaction of protein, and which sometimes are found in the urine in such quantities as to give it a brownish or even a blackish color.

But by no means all the poisons produced by putrefaction processes in the intestine appear in the urine. Through the action of the intestinal mucous membrane, the liver and various antitoxic glands, a considerable portion of these toxic substances is either destroyed or so changed that their toxicity is very considerably decreased.

Animal parasites are nearly always present in dogs and other carnivorous animals, and are not infrequent in the intestine in man, but the parasites found in the human intestine rarely do much injury, though they sometimes encourage infection by typhoid bacteria by wounding the intestine, and occasionally give rise to appendicitis.

Intestinal Antiseptics Harmful.

An investigation conducted by Nicate and Schulz (*Berlin Klin. Woch.*, June, 1900) shows that intestinal antiseptics diminish the ability of the intestine to destroy bacteria. After a dose of castor oil and calomel, cholera germs were found in abundance in the stools of dogs to whom cultures of this micro-organism had been given, while before the calomel was given, no bacteria were found, although cholera germs in quantity had been introduced into the intestine in such a way as to avoid action by the gastric juice. This experiment indicated that the intestine has in some way the power to destroy bacteria, probably, as suggested by Buchler, by means of a special ferment, and that the action of calomel interferes with the action of this protective process.

The observation that disease germs are destroyed in the normal intestine has been confirmed by Eiskamp and Park (*Jour. of Infectious Diseases, Jan.*, 1921), who noted that the pathogenic organisms disappeared in the intestine in two to seven hours.

Thyroid Extract in Intestinal Toxemia.

Borsch recommends the use of thyroid extract for neutralizing or distoxicating the poisons absorbed from the colon. This practice would seem to be justified by the facts known respecting the function of the thyroid gland. It is well known that dogs from which the thyroid gland has been removed die when fed on a meat diet, but live and prosper when fed on a diet from which meat is excluded, doubtless because of the lessened production of putrefactive poisons in the colon.

Gastric Toxicity.

It was long ago discovered that the secretions of the stomach are more or less toxic. Among the observations made was the fact that a hypodermic injection of a solution of morphia or similar poisons is quickly followed by the excretion of the poison into the stomach. For example, half an hour after the injection of a quarter of a grain of morphia, one-half of the quantity has been obtained from the gastric contents withdrawn by a stomach tube.

Roger found in experiments upon dogs and rabbits that when intestinal putrefaction is active the toxins absorbed are excreted into the stomach in large quantities. M. Borri conducted a series of experiments for the purpose of determining the degree of toxicity of the gastric contents obtained after a test breakfast in normal and diseased conditions. The results showed that in hyperacidity toxicity is very much increased. That this is not due to the acid was proven by the fact that the toxicity was increased even when the acid was neutralized. Toxins were also increased when motility of the stomach was diminished. The toxicity is also increased in gastritis.

The toxicity was found to be increased also to an extraordinary degree in cases of hysterical vomiting accompanied by headache, disturbance of vision, general depression, and various nervous disturbances. In these cases even water passed through the stomach by means of a tube was found to be very toxic. This hypertoxicity disappears as soon as the attack ceases.

These observations furnish a rational explanation for the headache, sense of weight and pressure in the head, mental inertia, general feebleness and other symptoms which accompany disturbance of gastric motility and other forms of indigestion; they also show why gastric lavage usually gives such great relief in cases of gastric disorders accompanied by slow emptying of the stomach.

TESTS OF THE NUTRITIVE FUNCTIONS

The purpose of this brief chapter is not to present the technical details of medical examinations in relation to digestion, but briefly to describe the several physical examinations and laboratory tests which may be utilized in the investigation of gastric and intestinal disorders.

Examination of the Mouth.

Every examination of the digestive functions should begin with the mouth. It should include, to be complete, an inspection of the tongue, examination of the teeth by a competent dentist, an X-ray examination of the teeth and a bacteriological and chemical examination of the saliva. The mouth has formerly received much less attention than it deserves, and we still lack much of knowing all that needs to be known concerning the various conditions found in the mouth.

Significance of the Coated Tongue.

The *tongue* naturally receives first attention in the examination of the mouth. Old medical writers attached great significance to the various coatings and other appearances presented by the tongue, but modern medical researches have shown most of these views to be erroneous. Many years of observations have convinced the writer of the truth of the suggestion of the eminent French physician, Lasegue, "*La langue ne denonce pas la maladie, mais l' etat du malade qui en est atteint.*" (The tongue does not indicate the disease, but the state of the patient).

To understand the significance of the coating of the tongue, it is necessary to remember that the mouth, next to the nasal cavity, is of all parts of the body most exposed to contact with germs and microörganisms of all sorts. The warm, moist cavity of the mouth affords an ideal incubating chamber, in which the numerous bacteria swept in with each incoming breath may grow and develop luxuriantly unless prevented from doing so by some special provision. The only reason why the tongue and all the mucous surfaces of the mouth are not always thickly coated is because the saliva, under normal conditions, prevents the growth of the various yeasts, molds and other organisms, which a microscopic examination shows to be present in countless numbers in the material scraped from a coated tongue.

The studies of Metchnikoff, Wright, and others have shown that the blood contains alexins, opsonins and other subtle agents which hinder the growth and development of bacteria. Under normal conditions, the white cells of the blood, or leukocytes, of which the blood of a person of ordinary size contains more than 30,000,000,000, are constantly active in destroying the bacteria which are continually finding their way into the blood stream; and thus, so long as an individual remains in perfect health, the blood is kept free from these invading enemies of the body. Although countless millions of these organisms daily find their way into the blood from the intestine, especially the colon, they are destroyed as rapidly as they enter, and so do not obtain a foothold within the body.

The saliva is formed from the blood and for a time after being freshly secreted, it possesses the same germ-resisting properties exhibited by the blood. The same is true of milk when freshly produced and still warm from the body of the cow. Small numbers of typhoid fever germs introduced into such milk rapidly disappear. The freshly secreted saliva contains not only the same opsonins and alexins found in the blood but also great numbers of white blood cells. As it pours into the mouth from the salivary ducts, it floods the tongue and teeth and other mouth surfaces, coming in contact with any bacteria which may have been lodged in the mouth and so preventing their development; and the white cells, though outside the blood vessels, may continue their work of capturing bacteria. And thus the mouth under normal conditions is kept clean.

When the mouth is dry, as in fever, when the salivary glands are paralyzed and produce very little saliva, the tongue becomes thickly coated by the growth of bacteria, molds, yeasts and other fungi. Persons who sleep with the mouth open have the tongue coated in the morning because the surfaces are dried and no longer bathed with the germ-resisting saliva.

But there is still another and much more common cause of coating of the tongue. The power of the blood to deal with germs and germ toxins is necessarily limited; hence, in autointoxication, when the body is flooded with putrefaction products, and virulent bacteria swarming in countless myriads in the alimentary canal find their way into the blood in unusual numbers, the germ destroying properties of the blood and saliva are exhausted. The same condition of the blood may result from germs and germ poisons derived from other sources than the alimentary canal; thus a coated tongue is practically always found present in fever, no matter what the cause of infection. A coated tongue may be regarded as practically always an indication of a toxic condition and lowered resistance to bacteria, as the result of which the saliva has been rendered incapable of affording the mouth the natural protection which it gives in conditions of health.

When the tongue is thickly coated, the breath has a bad odor and not infrequently a characteristic fecal odor. In such cases, there will always be found very pronounced intestinal stasis, the food residues and other body wastes being retained in the colon for days, instead of being promptly dismissed from the body.

When the colon functionates in a normal manner, that is, empties itself of its contents three times a day, or after each meal, there is no time for putrefaction and the absorption of toxic materials. Under normal conditions, the colon will not contain the residues and wastes of more than three meals; but when the bowels move but once daily, perhaps then imperfectly, the residues of six to ten meals, or even more, accumulate in the colon, and by their long retention in this excellent incubating chamber in contact with various species of putrefactive bacteria, they reach a highly advanced state of putrefaction; and this may be true even though the amount of meat or other highly nitrogenous products eaten is small, for the reason that the mucus produced in all parts of the alimentary tract and the residues of most of the digestive juices are all highly putrescible substances and supply abundant food material to promote the growth of putrefactive organisms in the colon.

To make things worse, the overstretching of the colon with accumulated residues breaks down the ileocecal valve, an admirably constructed and most efficient check valve provided by Nature to prevent the return of the feces into the small intestine when they have once been disposed of by being pushed out of the small intestine into the waste receptacle of the body.

A chronically coated tongue, with a fecal odor of the breath, is an almost certain indication of incompetency of the ileocecal valve and the need of a change of the intestinal flora (p. 552).

The Teeth.

As a result of bacteria in the mouth the teeth undergo decay and the gums become the seat of bacterial growth. These pernicious organisms even penetrate to the roots of the teeth, producing abscesses and infections which may insidiously attack almost every organ and structure in the body. Rheumatism, neuritis, disease of the eyes, even gastric ulcer, duodenal ulcer, gallbladder disease and appendicitis, may find their origin in these infections of the mouth.

A thorough examination of the teeth should include not simply inspection by a dentist but also a careful X-ray examination.

In a special study of the teeth as related to digestion, made more than twenty years ago, the writer found that there exists a definite correlation between the state of the teeth and the function of the stomach, showing very conclusively a close relation between certain gastric disorders and the condition of the teeth. Some of the facts noted may be of interest. Of the one hundred cases examined, only two had perfectly sound teeth. Of persons suffering from a deficiency of gastric acid (about one-half the total number of cases studied) the average number of sound teeth was ten, whereas in the less advanced cases of digestive disorder, the average number of sound teeth was twenty. Of the persons suffering from simple dyspepsia, none had been compelled to resort to the use of artificial teeth, whereas among the fifty-one persons suffering from a deficiency of gastric acid, twelve were dependent upon artificial teeth, five having upper sets only, and seven having both upper and lower sets. Among the persons suffering from infection of the stomach or gastric catarrh, the number of sound teeth was only about one-half as many as in persons not so affected.

The Saliva.

The saliva should be included in a thoroughgoing examination of the mouth. A bacterial examination will give some idea of the state of the alimentary canal as regards bacterial infection. If the mouth is badly infected with putrefactive germs and disease-producing organisms, especially if the colon bacillus is found present, it may be taken for granted that the whole alimentary canal, with the possible exception of the stomach, is infected with pernicious bacteria.

More important still is a test of the digestive properties of the saliva. Some years ago (1890) the writer began the systematic study of the digestive power of the saliva, and soon discovered that wide differences existed in the digestive activity of the saliva produced by different persons. The plan of examination adopted was that devised by Sir William Roberts in his study of the effects of acids upon salivary digestion, the technic of which need not be given here. This method was employed in testing more than fifty thousand salivas. Very great differences were found in the digestive power of the saliva. In a few cases it was found to be almost wholly inactive. Gum chewing rapidly depreciates the activity of the saliva.

While the great physiologist, Magendi, certainly was wrong in his supposition that the saliva is "the principal solvent of alimentary matter," it has recently been shown that cooked starch which has not been acted upon by the saliva interferes with gastric digestion by absorbing the pepsin, leaving hydrochloric acid in excess, and so giving rise to hyperacidity.

The action of the saliva in liquifying the starch of the food is a necessary aid to its disintegration, thus preparing it for the action of the gastric juice and succeeding digestive fluids.

Tests for Gastric Digestion.

A third of a century ago, gastric disorders held a much more prominent place in the minds of clinicians than at the present time. The teachings of Glenard, Dujardin-Beaumetz, Ewald, and other clinicians, focused attention upon the stomach as chief offender in the physical economy. But modern physiology has shown that the stomach holds a secondary place in the work of digestion, since it may be dispensed with when rendered useless by disease and apparently without serious interference with nutrition or the major vital functions. Many disorders once charged to the stomach are now believed to be properly chargeable to the colon, a veritable Pandora's Box of ills and miseries. Nevertheless, the stomach still holds a large place in clinical medicine, and is the undoubted seat of a considerable number of painful and crippling maladies and subject to numerous functional disturbances which may be remedied by judicious treatment and especially by careful and rational feeding.

For success in dealing with gastric disorders by dietetic means, it is of first importance that the exact nature of the derangement should be understood. Thirty years ago this was rarely possible. The meager means of investigation then available left the physician to depend largely upon shrewd guessing for his diagnosis in a very large proportion of cases. But this is no longer necessary. Modern methods of studying gastric disorders are sufficiently exact to enable the up-to-date physician by a searching examination to ascertain with a reasonable degree of certainty the real conditions present in any individual case. Such an examination is not only desirable but essential in every case as a foundation for the scientific application of modern, rational dietetics.

The Test Breakfast.

The test breakfast of Ewald introduced a new era in the treatment of diseases of the stomach. This breakfast consists of two ounces of bread with eight ounces of water. At the end of an hour from the beginning of the breakfast, a stomach tube is passed into the stomach and its contents evacuated, filtered, and examined for total acidity, the amount of free hydrochloric acid present, the amount of combined and fixed acid, the digestive activity, as shown by the digestion of egg albumin in Mett's tubes. Tests are also made for the rennet ferment, for lactic and other organic acids. A bacteriological examination is also made.

The Fractional Test Meal.

A fractional examination of the gastric fluid has been shown to be of special value. This test is made by the aid of a small tube, which is swallowed and allowed to remain in the stomach during the entire test. The gastric fluid is withdrawn at intervals of fifteen to thirty minutes and tests are made for free hydrochloric acid and total acidity. Hayem and Winter, who made the first thoroughgoing studies of the gastric fluid, were also the first to make these fractional tests, which have only recently been fully appreciated, since their value has been demonstrated by Rehfuss and others.

In some cases the secretion of acid, though ample at the start, soon fails. Cases are also found in which there is only a little acid in the stomach at the end of an hour, but half an hour later a large amount. These cases of hyperacidity were quite frequently overlooked when the examination was confined to the Ewald method. The fullest information concerning the work of the stomach is to be obtained only by a combination of the Ewald and the fractional methods. To the ordinary methods devised by Ewald, Toepfer, Hayem and Winter, which are found most efficient when used in combination, the writer added many years ago (1892), a method for determining the amount of work done by the saliva in the stomach as shown by the degree to which the starch is digested.

The Water Meal.

A pint of warm water is introduced into the stomach and small quantities withdrawn for testing at intervals of fifteen or twenty minutes.

Water is a gastric stimulant. By its use it is possible to determine whether mucus or other abnormal products are being formed by the stomach; also to ascertain whether there are present secretions which have been regurgitated from the duodenum.

Tests for the Chemical Secretion.

The small gastric tube having been introduced into the stomach, a test meal is introduced through the tube, care being taken that no food comes in contact with the mouth. Various meals may be used, as simple water, animal or vegetable extracts, milk, purées of cereals or vegetables, oil, or combinations. Fluid is withdrawn at intervals for examination.

Test for the Psychic Secretion.

A small tube is introduced into the empty stomach and the subject is then allowed to see, smell, and taste food, but to swallow none. Samples of the gastric secretion are withdrawn at intervals of fifteen minutes for examination.

Test for the Condition of the Gastric Glands.

Taylor calls attention to the fact that if acid protein is given in cases of achylia, ferments are very often formed. If ferments are not formed, it is concluded that the glands are degenerated; hence this test should be applied in every case in which ferments are absent, by the giving of acid protein (protein + HCL). In cases in which acid protein causes the ferments to appear in the gastric fluid when previously absent, it should be used with each meal as an aid to the glands until the ferment-forming function is restored. The continuous use of acid protein (Acidone) is necessary when no hydrochloric acid is formed.

Capsule Test for Gastric Activity.

A simple test of much value as a means of determining whether the stomach retains or has lost its power to digest protein is based upon the fact that the gastric juice alone, of all the digestive fluids, is able to digest raw connective tissue. The test is carried out by the use of three beads connected by thread and also by a bit of raw catgut. These are placed in a perforated capsule, which the patient swallows at meal time. The following day's examination of the stools is made to find the beads. If the catgut has disappeared, the gastric juice is known to be active. If not, achylia is probably present; that is, the stomach glands have ceased to make an active gastric juice. In such cases it is necessary to repeat the test, giving a quantity of acid protein (Acidone). If the catgut does not then appear, the gastric glands are still capable of producing pepsin, but for some reason are not active. The regular administration of Acidone is necessary. But if the catgut is present, it is evident that the gastric glands have undergone degeneration.

The Barium Meal.

Soon after the discovery of the X-ray, it became evident that valuable information might be obtained by the use of a test meal containing substances opaque to the X-rays. First, nitrate or carbonate of bismuth was employed for this purpose. Later, barium was substituted. For the efficiency of this plan of examination, the world is largely indebted to Dr. James T. Case, of the Battle Creek Sanitarium, who has contributed much to the perfecting of the technic of this valuable method.

The digestive apparatus has two distinct classes of functions. One of these is concerned with the transformation of the food from insoluble or non-absorbable substances into soluble and absorbable products which may be utilized by the body in building and repairing the vital machinery and in replenishing the vital energies of the body. This work is done chiefly by the aid of the digestive juices, which are formed by glands placed at various points along the digestive canal, chiefly in its upper part.

A second class of functions consists of mechanical treatment of the foodstuffs by which they are (1) reduced to a soluble or pultaceous state, then (2) mixed with the digestive juices, (3) spread out upon the intestinal wall so as to aid in absorption, (4) moved from one part of the alimentary canal to another, constantly in the same direction, and (5) when reduced to the unusable residues, discharged from the body.

The Ewald meal and chemical examination of the stomach fluid gives us information concerning the first class of functions —the action of the digestive juices upon the food. The barium meal gives information concerning the second class of functions, which are executed by the muscular walls of the intestine. The information obtained by the aid of the barium meal is of even greater value than that secured by the test breakfast; but for complete information it is necessary that both methods be employed. It is further to be noted that the barium meal not only advises us concerning the stomach, but visualizes the entire alimentary canal from mouth to anus, giving information concerning the conditions of the small intestine, the colon, the gallbladder and the liver, which facts are of even greater importance than those elicited concerning the stomach by the Ewald meal.

The following is a brief resumé kindly furnished me by Dr. J. T. Case of the principal conditions concerning which information may be obtained by the opaque (bismuth or barium) meal:

Ulcer, cancer or tumor of the stomach, cardio-spasm, spasm of the oesophagus, spasm of the pylorus, distortions of the stomach, cysts and tumors of the pancreas, adhesions of the pylorus, ulcer of the duodenum, distortions, obstructions and adhesions of the duodenum, gall stones, adhesions of the gall bladder, location and changes in the liver, abscess in or about the liver, tumors, cancer, ulcers and other changes in the small intestine, incompetency of the ileocecal valve, adhesions of the intestine, adhesions of the colon, disease of the appendix, dilatation and adhesions of the cecum, cancer of the colon, tuberculosis, syphilis, atony, colitis and spasm of the colon.

The Motility Test.

The rate at which the undigested foodstuffs are moved along the alimentary canal is termed its motility. The barium meal affords an exact and scientific method of studying the motility of the alimentary tract. Another very simple and highly practical method, affording final results which agree very exactly with those obtained by the barium meal, is the following:

Two capsules, containing together about fifteen grains of carmine, are swallowed with the breakfast. In place of carmine a teaspoonful of bone black or finely pulverized charcoal may be used. The carmine or the charcoal mingle with the food, giving it a characteristic color which can readily be recognized in the stools. After the administration of the carmine or charcoal, the stools are carefully watched and the exact time noted when the color first appears. Further observations are made until the color disappears, the time of which is also recorded. The time of the first appearance of the color has long been in use as a means of determining motility, but the writer's experience has been that this is not the true measure of the motility rate, but that the motility time is marked by the disappearance of the color. This time is found to correspond very accurately with the results obtained by the use of the barium meal. Some thousands of observations made under the writer's supervision indicate that the motility period may vary from eight or nine hours to several days.

It is found that persons whose bowels move once a day usually have a motility period of fifty hours or more. When the bowels move thoroughly three times a day, the motility period is reduced to sixteen to twenty-four hours.

The normal motility rhythm is in the writer's opinion the following:

The breakfast residue is discharged some time between supper and bedtime; the dinner residue before breakfast the next morning or not later than soon after breakfast; the supper residue after breakfast or not later than soon after dinner the following day. When this normal motility rate is maintained, the time which the food residues remain in the body will be, for breakfast, 13 to 15 hours; for dinner, 17 to 20 hours; for supper, 15 to 20 hours.

When the body wastes are dismissed in this prompt and regular manner, there is no time for putrefaction; wild bacteria cannot obtain a foothold, the normal acid-forming flora of the intestine is dominant, and the vital machinery is not crippled by the absorption of the enormous quantities of highly toxic substances which are constantly pouring into the blood when the food residues and body wastes are retained so long in the colon that they become putrid.

This is the normal or ideal alimentary cycle, but it is by no means realized in actual experience. The colon of the average man is in the condition of a congested railway system. The right of way is choked, and if bowel movements occur, they are belated, —two or three days in arrears; the residues of half a dozen or more meals being packed away in the colon undergoing putrefaction and poisoning the body.

The motility test is invaluable in connection with diet and treatment for changing the intestinal flora, and should always be used in connection with this method as a means of checking the results obtained, in addition to careful bacteriological studies.

Examination of the Gallbladder.

The X-ray examination of the gallbladder region often gives information of great value concerning the condition of the gallbladder. Gallstones are sometimes seen. A certain proportion of cases, however, remain obscure, and in these some help may be gotten by the use of the Metzer-Lyon method of obtaining specimens of bile, which is as follows:

The test is made before breakfast, twelve hours after the last meal. The patient is placed on the right side, with the left limb drawn up over the right, so as to get the gallbladder region as low down as possible. A Rehfuss stomach and duodenal tube is introduced. The position aids the tube in entering the duodenum so as to bring the bulbous end of the tube near the mouth of the bile duct. The tube will usually reach the duodenum in ten to sixty minutes. When it is certain that the bulb is in the duodenum some of the duodenal fluid should be collected. The first fluid obtained should be a "pearly fluid" with little mucus, and alkaline in reaction. If the duodenum is diseased, many germs will be present and the fluid will be turbid.

The next step is to inject with a small syringe through a tube one and two-thirds ounces of a 25 per cent. solution of magnesium sulphate. This will cause relaxation of the bile ducts and opening of the common duct, with discharge of bile from the gallbladder. By gentle suction on the syringe, some of the fluid may then be withdrawn, after which the tube is disconnected and hung over the side of the couch to drain. The first liquid will be clear duodenal fluid, bile and sulphate solution mixed. In ten to thirty minutes the bile will become darker and more viscid. This is gallbladder bile. If the quantity is large,—more than two and two-thirds ounces,—there is probably stasis in the gallbladder. After a time the bile again becomes thinner and lighter in color, coming direct from the liver.

Normal bile is free from germs unless contaminated by duodenal contents. Cultures prove sterile. If no bile can be obtained, the common duct may be obstructed. If only clear, light-colored bile is obtained, there may be obstruction of the cystic or gallbladder duct.

A two per cent solution of citric acid may be used instead of magnesium sulphate solution.

The benefit which sometimes results from this mode of gall bladder drainage is probably due to the getting rid of a quantity of stale and concentrated and hence highly poisonous bile.

Examination of the Stools.

The chemical and microscopic study of the stools is of great importance, not only as a means of investigating the residual products of digestion but also for the purpose of detecting the presence of animal parasites, tapeworms, the amoeba of tropical dysentery, etc.

Chemical and macroscopic as well as microscopic examinations are also made for undigested food, parasites, blood, mucus, and other evidences of pathological conditions.

The examinations are repeated until the flora is changed and the stools lose their putrid character and become in other respects normal.

Some of the most significant indications in relation to the stools are the following:

The Color. Very light or clay-colored stools signify the absence of bile. Pancreatic digestion may be deficient also. Such stools are usually very foul smelling.

Dark-colored stools denote putrefaction. The stools of a healthy breast-fed infant are light yellow in color and nearly odorless. When they become brown or dark, the child is sick and toxic. Black stools may indicate blood from hemorrhage.

The normal stool is of a yellowish color and soft consistency. The so-called "well-formed stool" is an indication of chronic constipation. It occurs when the bowels move but once daily, a form of constipation usually mistaken for an indication of health.

The Odor. This is most important. Normal stools have a slightly sour odor or a very faint fecal odor, but no suggestion of putridity. A putrid, strong, ammoniacal or rancid (butyric) odor is a certain sign of putrefaction; and when putrefaction is present, there are also infection, colitis and autointoxication.

Lumpy stools indicate a spastic state of the colon, probably due to colitis.

The presence of mucus is a certain sign of colitis.

Frothy stools with a sour odor indicate very active fermentation.

Gas or flatulence accompanying the stool indicates the presence of the pernicious Welch's bacillus and other gas-forming organisms, especially the colon bacillus.

Bacteriological Examination of the Stools.

Most important of all is the bacteriological examination of the stools by modern methods. Examination of the stools with reference to typhoid and other intestinal infections is of course important, but of far greater importance is examination to determine the character of the dominant flora present in the intestine, particularly in the colon. The normal flora of the colon is fermentative, or acid forming. The dominant organism present is *B. acidophilus,* a germ which produces lactic acid and does not produce gas. This germ appears as the dominant flora in very young healthy children. It is also found in the colons of chickens, monkeys, rats and other animals when fed on food rich in carbohydrates and given no meat.

In adults on a mixed diet the *B. acidophilus* is found in the stools only in very small numbers if at all. The dominant flora is putrefactive. That is, the food residues are of such a sort that they undergo putrefaction in the colon. Putrefaction is encouraged by the constipation generally present in the average American. A bacteriological examination shows the presence of Welch's bacillus, a common putrefactive germ and the organism which causes gas gangrene. The colon bacillus is also present in large numbers with various other putrefactive and poison-forming germs.

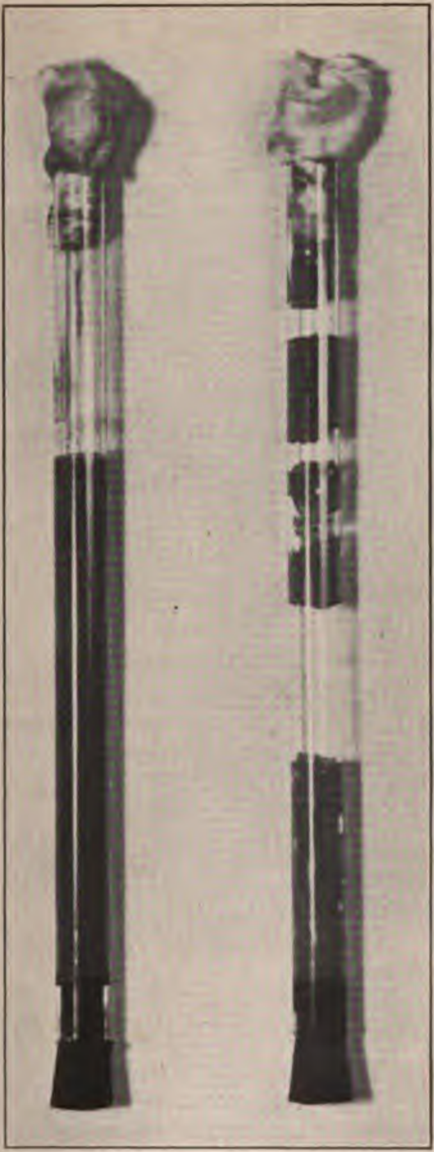
By means of bacteriological cultures, the character of the flora may be readily determined. The presence of large quantities of gas shows the presence of Welch's germ. Small gas bubbles in the Veillon tube indicate the colon bacillus. The absence of gas and characteristic colonies show the presence of *B. acidophilus,* the normal acid-forming flora. As the flora improves under proper feeding, the gas gradually diminishes until it disappears when the flora is "changed," and the *B. acidophilus* becomes dominant.

The accompanying cuts show the appearance of the Veillon culture tubes before and after changing the flora.

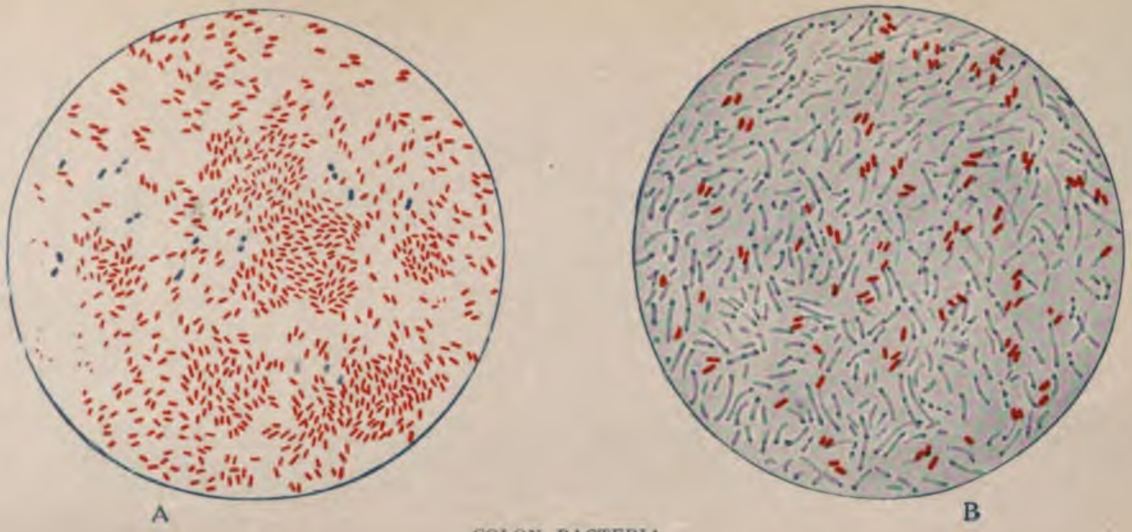
The Blood.

The normal blood count per cubic millimeter is five million red cells and about seven thousand white cells. The total number of red cells in the body of a man of average size is about twenty-five million million. The absorbing surface presented by the red cells is about 82 square rods, more than one-half acre. It is the function of the red cells to absorb oxygen, which is taken up and concentrated by the hemoglobin, an organic iron compound to which the red corpuscles owe their color. The blood of a well-developed man contains about forty grains of iron.

In the words of the old prophet, "The blood is the life." The blood was held as sacred by the ancients because it was believed to be the seat of the life principle of the body. The modern physiologist recognizes the fact that the blood is the vitalizing element of the body, that it creates and maintains the



Veillon Tube Cultures Showing, A. Flora Changed, No Gas; B. Putrefactive Flora, Welch's Bacillus, Much Gas



COLON BACTERIA

The red color indicates species which produce putrefaction and give rise to toxins; the blue color, acid-forming organisms which are friendly. A. Stool from a child suffering from intestinal toxemia. B. Same case ten days later after flora was changed by a change of diet and other measures.

body; in other words, that it is in a literal sense the life of the body.

It has long been known that oxygen is carried by the red blood cells. It has been supposed, however, that the transport of the carbon dioxide was chiefly accomplished by the serum or plasma of the blood. Recent observations by Joffe have shown that at least two-thirds of the carbon dioxide is carried by the red blood cells. It is now known that the red blood cells carry oxygen from the lungs to the tissues and carbon dioxide from the tissues back to the lungs. The little burden bearers are always loaded.

In anemia the blood iron is reduced and the blood cells may also be reduced in either greater or lesser proportion than the coloring matter of the blood. In a person whose hemoglobin is 50 per cent. for example, the blood contains only half the normal amount of iron, which means that the vital resistance, endurance, and ability to cope with disease are proportionately reduced. His stream of life is at a low ebb. When the white cells are reduced, the ability to resist the invasion of bacteria is depreciated, since it is upon the white cells that we depend for defense against these invisible enemies. Whenever infection occurs, that is, whenever disease-producing germs find entrance to the body, the white cells usually increase in number very rapidly. This is simply the rallying of the defenders of the body to combat the invading enemy. For example, when an attack of appendicitis is developing, the white blood cells may within a few hours increase from 7,000 per cubic millimeter to 20,000 or even more. At the beginning of an attack of pneumonia the increase may reach a hundred thousand, many times the original number. In general, an increase of the white cells in the blood indicates bacterial infection.

The white cells are usually increased after meals, doubtless because the number of bacteria entering the blood from the intestine is also increased after eating, requiring a greater number of white cells to deal with them.

Chemical Examination of the Blood.

Chemical examination of the blood is of the highest importance. Though not as yet in general use, this method, thanks to the new and exact technic of Folin, is now thoroughly practical, and its use is most desirable, almost indispensable, in certain classes of disorders. This is, indeed, the most exact means of determining the degree of efficiency of the kidneys. It is the function of the kidneys to remove waste matters from the blood. These toxic substances taken collectively, are termed non-protein nitrogen. By drawing a few drams of blood from a vein by the aid of a suitable syringe and a fine needle, the exact amount of non-protein nitrogen present in a given quantity of blood may be readily determined. By this means it is possible to ascertain the amount of waste matters left in the blood by inefficient kidneys. The normal amount of this substance is 28 to 32 milligrams (one-half grain) per 100 cubic centimeters (three and one-third ounces of blood. When the amount of non-protein nitrogen is much greater than this, there is reason to suspect a considerable degree of renal inefficiency; that is, the kidneys are not able to remove from the blood the waste matters which it is their duty to extract from it.

The determination of an increase in the amount of uric acid present in the blood is the best means of detecting the earliest indications of failure of the kidneys to perform their work efficiently. An increased amount of creatinin in the blood indicates that disease of the kidneys is far advanced.

A knowledge of these conditions is of the utmost consequence, as it shows a necessity for the establishment of a rigorously low protein diet, which might not otherwise be considered justifiable, but is absolutely required for the prolongation of the individual's life.

Sugar is normally found in the blood in the proportion of about one part in one thousand. When the sugar is increased considerably beyond this amount it appears in the urine, and the patient is said to have diabetes. Examination of the blood, however, often shows a marked increase of blood sugar when it has not yet appeared in the urine; hence, an increase of blood sugar is a most important symptom of the approach of diabetes.

The so-called Wassermann test and various other serological tests are important as means of indicating the presence of syphilis and other infections, which may be recognized by changes in the blood.

The Urine.

The urine is an extract of the tissues. It represents to a large extent the acid wastes of the body, while the bile represents the alkaline wastes. The quantity of the urine, its specific gravity, the amount of urea, uric acid and other substances, are all highly important in measuring the tissue changes which are taking place. The amount of ammonia, indol, and other putrefaction products, also the presence or absence of albumin, casts and other abnormal elements, are most important means of judging of the kind and extent of morbid changes which may be taking place in the body.

A high protein diet is necessarily accompanied by a great increase in the amount of urea and uric acid. Folin has shown, in fact, that urea represents the excess of protein which has been eaten, the only use for protein being to make good the wear and tear of the living tissues. Any amount beyond the small quantity required to accomplish this, instead of being built into tissue, is directly carried out of the body as so much waste matter. It will thus be readily seen how great a burden is imposed upon the kidneys by the extra work required of them in the elimination of surplus protein eaten in the form of steaks and chops.

Still another extra burden thrust upon the generally overworked kidneys when an excess of protein is eaten, is the necessity for the elimination of the indol, skatol, and other poisonous products resulting from the putrefaction in the colon of the undigested residues of meat and other food substances rich in protein. These putrefaction products are probably the source of the ammonia which is found in the urine in quantities closely proportional to the amount of meat eaten.

Tests of the Urine.

Diabetic patients, when possible, should be instructed in the methods of examining the urine, so that they may be able to note the effects of diet and to detect at once the appearance of threatening symptoms in their own cases. The following directions for testing the urine are borrowed from the author's work on diabetes*:—

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* "The New Method in Diabetes," by J. H. Kellogg, M. D., Modern Medicine Publishing Company.

Collection of the Specimen.

Use for the purpose only glass jars or bottles which have been thoroughly cleaned and scalded with boiling water. During the collection keep the jar well covered and in a cool place. The specimen to be analyzed should cover a period of twenty-four hours, and should be obtained in the following manner:

Empty the bladder at the usual time of rising in the morning, say 7 A. M. This is to mark the beginning of the collecting period hence, this passage is *not to be saved.* Then carefully save all the urine passed until 7 A. M. the next day, taking care to completely empty the bladder at this time. If the quantity is so large as to require several containers to hold it, the whole of the twenty-four-hour collection should be poured into one vessel large enough to hold it all, so as to secure thorough mixing. Note the total quantity, being careful to measure very accurately. If it is desired to send to the laboratory a specimen for complete analysis, fill a perfectly clean bottle or jar, holding at least one pint, with the mixed urine, seal properly and label with the name and the total quantity of urine passed during the 24 hours. A half dram of toluol may be added to preserve.

The following tests should be made:

1. *The specific gravity.* Place enough urine in the cylinder to float the urinometer. Take the reading just below the surface of the urine. The urine tested should be at the ordinary room temperature, which will be the case if the specimen has been standing in a room of ordinary temperature for some hours. The normal specific gravity is 1016 to 1020. A high specific gravity gives ground for suspecting sugar. As the sugar of the urine diminishes, the specific gravity will fall.

2. *Diacetic acid.* Five c.c. of the urine (a large teaspoonful) is placed in the test tube. Add, drop by drop, the ferric chlorid solution as long as a precipitate forms. Filter, and to the filtrate add a few drops more of ferric chlorid. If diacetic acid is present, a violet-red color will result.

This test can be made without filtering, as follows:

To three or four c.c. urine (a small teaspoonful) in the test tube, add an equal amount of ferric chlorid. If diacetic acid is present, the violet-red color will appear. This color may be due to other substances; but if on heating the mixture the color fades, it is an indication that the color was due to diacetic acid.

3. *Test for Sugar in the Urine.* To test for sugar, five c.c.

(a large teaspoonful) of the test solution is placed in a test-tube. Add eight to ten drops, not more, of the urine to be tested. While shaking, the mixture is heated to boiling and kept at this temperature for two minutes, or the tube may be held in boiling water for five minutes. It is then allowed to stand until cool. In the presence of sugar, the entire body of the solution will be filled with a precipitate, which may be *red, yellow,* or *greenish* in tinge. If the quantity of sugar as low (under 0.3 per cent.), the precipitate forms only on cooling. If no sugar is present, the solution either remains perfectly clear or shows a faint turbidity that is blue in color.

If the above tests show even a trace of sugar or diacetic acid, the diet must be changed at once. A fast day, or even a green vegetable day, will usually suffice to cause the sugar to disappear. If a trace of sugar still persists, a second or even a third day of fasting may be necessary. Then the diet must begin at a lower level, say one-half the former amount of carbohydrate; and if the acid test is very pronounced, reduce the fat to two-thirds the former amount. Then gradually increase the amount of starch or fat from day to day, stopping a little short of the amount of carbohydrate or fat which caused the sugar or acid to appear. After some time, a week or two, another attempt may be made to increase the amount of carbohydrate or fat. This increase should follow a green diet day.

Many other tests of the urine, qualitative and quantitive, are necessary for a complete study of this most important excretion, which normally carries off two-thirds of all the poisonous wastes of the body. The rapid increase in the mortality rate from Bright's disease and other renal disorders points to the importance of giving greater attention to the prevention of this class of maladies. In the lessened consumption of meat, tea and coffee, and the restriction of the tobacco habit, will be found the most efficient means of prophylaxis against this grave disease. Every adult should have a careful examination of his urine made at least once a year. Too often, disease of the kidneys becomes far advanced toward a fatal termination before it is discovered. Scanty and high colored urine or an unusually large amount of it, painful urination, frequent urination, sediments in the urine, are symptoms which should lead at once to a complete chemical examination by a competent chemist.

Metabolism Tests.

In the term metabolism is summarized the total vital activities of the body. All of these activities depend upon the consumption of oxygen, just as does the combustion taking place in a furnace. The amount of steam produced, and thus the amount of energy set free from the coal in a boiler plant or a locomotive, is determined by the amount of oxygen admitted to the boiler furnaces. In like manner, the amount of oxygen consumed in the body is an accurate measure of the amount of energy produced. Each cubic foot of oxygen burned means the liberation in the body of energy equivalent to 160 foot tons. Exposure to cold and muscular activity increase the rate of oxygen consumption and of energy expenditure.

By means of recently devised apparatus, it is now possible to make very exact measurements of the amount of oxygen consumed, and hence to determine accurately the rate of energy production in the body. The application of these tests has shown that the rate of metabolism is increased in certain diseases and sometimes to a very high degree. This is particularly true of hyperthyroidism, or "toxic thyroid," commonly known as exophthalmic goitre. There is also increase of metabolism in various other serious disorders, as in advanced cases of heart disease, pernicious anemia, in fevers, in hysteria, in arteriosclerosis, and in certain nervous diseases accompanied by extreme nervous tension.

The metabolism rate is commonly diminished in aged persons, and in certain diseases, as chlorosis, ordinary cases of anemia, cachexia, Bright's disease, and malignant diseases.

Tests for Acidosis.

A condition of the body in which there is a disturbance of metabolism which gives rise to an increase of acid substances in the blood and tissue fluids is known as acidosis. The importance of acidosis has not been appreciated until recent times and is as yet not so well recognized as it should be. Acidosis is most commonly the result of an excessive use of fats; that is, more fats are eaten than can be completely burned, and the imperfectly oxidized fatty acids found in the blood and tissue fluids give rise to various toxic symptoms. An illustration of the character of these compounds resulting from the imperfect combustion of fat is to be found in the smoke which arises from a partially extinguished taper or a smoking candle wick. The highly irritating products of this imperfect combustion, if present in considerable amount, are likely to give rise to highly dangerous symptoms, and, indeed, may even cause death through coma. Acidosis arising in this way is the cause of the so-called diabetic coma. Acidosis is always induced by the administration of a general anesthetic. Fatal acidosis has been caused in this way.

The condition of acidosis is often indicated by a sweetish or sweetish-sour odor of the breath, due to the presence of acetone. Acetone may also be found in the urine. The most accurate means of measuring the amount of acidosis present is by determination of the CO_2 tension of the residual air of the lungs. This is done by the use of a special apparatus, into which the patient breathes. The carbon dioxide is carried in the blood in loose combination with soda salts, which normally abound in the blood. When abnormal acids are present in the blood, they combine with the soda and thus prevent the taking up of the carbon dioxide from the tissues, where it is produced by the vital combustion continually taking place, in which oxygen combines with carbon in connection with muscular work and other vital changes. The minimum normal CO_2 tension is 34. When the tension falls below this it is evidence that the supply of oxygen to the tissues is insufficient, and acids are accumulating. In high health the tension is 40 to 45. Inability to hold the breath thirty seconds or more suggests acidosis.

The Body Weight.

The body weight is a simple and very practical metabolism test which should have more attention than it commonly receives. Rapid loss of weight may be due to excessive metabolism. This condition is often the result of worry, suspense, or anything which increases "nerve tension." The increased expenditure of energy is not due to increased activity of the nerves, but to an increase of the so-called muscle tonus, which in health and with the body in a state of rest, accounts for thirty to fifty per cent. of the total energy expenditure, but which may be increased one hundred per cent. or even more as the result of tension from exciting emotions, as well as exercise of the muscles.

Strength Tests.

Tests of strength are, when properly interpreted, a valuable means of determining general neuro-muscular conditions. Muscular effort is the result of the combined activity of nerves, nerve centers, and muscles,—the so-called neuro-muscular mechanism. Weakness may be the result of an impaired condition of either one of the three sources named,—an exhausted nerve center, an impaired nerve conductor, or a muscle exhausted because saturated with fatigue poisons. Exhaustion of the muscle may be quickly removed by the application to it of simple massage; while an exhausted nerve center may be restored only by the renewed accumulation of energy in its cells; and a damaged nerve conductor must be repaired. A muscle which has become permanently weakened by disuse can be strengthened only by carefully graduated exercise, the exact amount of which may be determined by careful dynamometric tests.

More than thirty-five years ago (1884-5), the writer began experiments for the purpose of devising means for measuring the individual groups of muscles of the body. After ten years' effort an apparatus was constructed, known as the universal dynamometer, which has now been in extensive use for more than twenty-five years. By means of this device the strength of each of the large groups of muscles in the body may be accurately determined. The results are then placed on a percentile chart, and a graph made, showing the relation of the strength of each group of muscles in the body to the strength of corresponding groups in a normal man of the same height. By this means one obtains a definite expression of the nutritive condition of the muscular system, which constitutes one-half of the weight and bulk of the entire body. By repeating the tests from time to time, a very accurate account of the general nutritive state of the body may be maintained. With increasing nerve tone and improving nutrition, strength increases notably, sometimes at the rate of four or five hundred pounds weekly. Such an increase of strength is of much greater significance than an increase of several pounds in body weight. Indeed, it is a positive indication of improvement, whereas increase of body weight might have the very opposite significance. In not a few cases improvement is measured by decrease in weight, but under no circumstances is a decrease of bodily strength to be counted as a gain.

Tests of Heart and Circulation.

The heart muscle expends in its activities about ten per cent. of the total energy output of the body when in a state of rest. The strength of the heart and its powers of endurance vary within almost as wide limits as does the strength of other muscles, though of course complete paralysis of the heart muscle cannot exist without immediate death. No dynamometer has yet been devised by which the strength of the heart can be measured, but useful information concerning its strength may be obtained by the use of the sphygmomanometer, an instrument for obtaining the blood pressure.

The method is simple. The blood pressure is taken, both systolic and diastolic, first with the patient lying, and then standing, and finally standing after gentle exercise for ten minutes. The pulse rate is also noted in both the lying and standing positions and in the standing position after exercise. The difference between the diastolic pressure and the systolic pressure is known as the pulse pressure. Both the diastolic and the systolic pressure normally rises when a person changes from the horizontal to the vertical position, the diastolic pressure rising more than the systolic.

The pulse is usually quickened on rising and still more after exercise. The pulse pressure really represents the efficiency with which the work of the heart is done, and is in a certain sense a measure of the blood moved from the heart into the arteries at each beat. If, then, the pulse pressure is multiplied by the pulse rate, the figures resulting will indicate the amount of blood movement per minute.

REGIMENS AND DIETARIES

While there are many special feeding indications for individual diseases, most of the hundreds of different maladies and morbid conditions which are encountered by the physician and the nurse may be grouped as regards dietetic requirements into a small number of classes; and most of the requirements may be met by some one of the following dietaries or regimens or a combination of two or more. Some of the dietaries described, for example, the laxative and the antitoxic dietaries, are applicable, with modifications, in most cases.

All Dietaries Must Supply Lime, Iron and Vitamins.

In arranging bills of fare, it is important to remember that certain elements must be found in every dietary which is to be followed for more than a few days. This is especially true as regards vitamins, lime, iron, and the alkaline salts. Hence, no matter what other food constituents may be reduced, the supply of iron, lime and vitamins must be kept up to the normal. It is especially important to bear this in mind in the treatment of cases of fever, obesity, peptic ulcer, and surgical cases.

THE FRUIT REGIMEN

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The fruit cure has been practiced in various ways. The most familiar is the so-called "grape cure." The patient takes ten to fourteen pounds of grapes a day and a few pieces of zwieback. The seeds and skins are excluded.

Linnaeus tells us of the cherry cure, which he himself employed with advantage.

During the Civil War the diarrhea and dysentery from which soldiers suffered were relieved during the peach season when the soldiers had access to peach orchards.

How Fruits Differ.

Fruits do not stimulate the bowel by irritation, but by the bulk that they furnish through the cellulose which they contain, and through their acids and sugars. Fruits differ in these properties. Apples and pears contain almost no cellulose, bananas contain practically none and are little laxative. Cherries, grapes, apricots and peaches contain more cellulose and are therefore more laxative. Prunes contain a considerable amount of cellulose and are highly laxative. Raisins are also laxative, as are figs. Dates are less laxative, but when freely used (one-quarter pound) three times a day, greatly aid the change of flora. Huckleberries contain the largest amount of cellulose of any food, and are very highly laxative. Raspberries and blackberries are laxative, but less so than huckleberries.

Fruits that contain much acid are prohibited in cases of hyperacidity, and sometimes in chronic gastric catarrh without hyperacidity, and also in achylia when the gastric mucous membrane has become hypersensitive to organic acids. In such cases, fruits free from acids should be taken, such as bananas, pears, white cherries, very sweet peaches, cantaloupe, watermelon and casaba melon.

The Daily Routine.

At the start, the patient should take a carmine capsule and note the time when the color appears and disappears. The character of the stools should also be noticed, especially the color and the odor. Putrescent stools are generally dark in color, either black or brown and have an ammonical, rancid or putrescent odor.

With the fruit regimen the patient takes four meals a day. Each meal consists of fruit,—any kind of fruit which agrees with the patient,—one-half ounce of bran and one ounce of paraffin oil. If desired, one ounce of brose (a mixture of equal parts by measure of oatmeal, corn meal and sterilized bran) made into a porridge, may be added twice a day. Roughage may be taken in the form of sterilized bran. For persons who cannot take bran, or think they cannot, agar-agar may be used instead. The bran or agar-agar should be divided into six or eight equal parts and distributed through the meal, so that it may be well mixed with the other foodstuffs. Three ounces of milk sugar should be taken three times a day, before meals. Quickest and best results are obtained when a concentrated culture of the *B. acidophilus* is taken with the milk sugar. This is of especial importance in cases in which the flora changes slowly, as in many cases in which the ileocecal valve is incompetent.

After three or four days of the "fruit regimen" the stool generally becomes nearly odorless and consists chiefly of bran. The fruit regimen should be continued until this change occurs, unless the patient is very feeble, in which case the diet may be changed and the patient allowed to take a more liberal bill-of-fare for a few days, when the regimen may be repeated.

In exceptional cases the diet must be continued for ten days or two weeks. When this is necessary, no serious inconvenience will be experienced by the patient, provided he is kept at rest.

In the case of very feeble or emaciated patients, the fruit regimen may be used for three or four days, and then followed by the milk regimen, which not only serves to perfect and establish the change in the intestinal flora, but secures a very desirable gain in flesh, often at the rate of half a pound a day or even twice as much.

Thin persons should rest while taking the fruit regimen, so as to avoid undue loss of flesh. It is not necessary to remain in bed, but the horizontal posture should be maintained, if not in bed, on a cot or a sofa, and always in the fresh air.

By the addition of lettuce, celery, and in some cases salads of carrots, turnips, cabbage, and palm cabbage when available, valuable vitamins are supplied, as well as nutrient material,—elements of the greatest value in rebuilding the diseased and deteriorated organism.

An especial advantage of the fruit regimen is that it is so simple that it may be employed by anyone, at almost any time and in almost any place. For good results it is only necessary that the rules here laid down should be carefully followed.

By this regimen all the good effects claimed by the advocates of fasting may be obtained, without the dangers and inconveniences of total abstinence from food.

Evidence that the Intestinal Flora is Changed. When the flora is changed, intestinal gas disappears, the stools are no longer foul or strong smelling, they are lighter in color, unless colored by spinach or other food, they usually have a slightly acid odor, chemical tests show acids dominant, and a bacteriological examination shows absence of Welch's bacillus and other putrefactive and gas-forming bacteria, very few colon bacilli, and an abundant growth of acid-forming bacteria, especially the B. acidophilus.

Keeping the Flora Changed. After the flora has been changed, it may be easily kept in a nearly normal condition by close adherence to an antitoxic diet (p. 568) and once in three or four weeks taking three ounces of milk sugar or lactose-dextrine or an ounce or two of *Acidophilus-Lactose* three times a day for two or three days. This should be done whenever the stools become foul smelling or when intestinal gas is troublesome. The continuous use of Acidophilus buttermilk is an excellent means of keeping the flora changed. Half a pint to a pint at each meal is required for best results.

The Green Regimen.

In certain cases of hyperhydrochloria the stomach is exceedingly sensitive to fruit acids, so that the fruit regimen gives rise to pain even when bicarbonate of soda and small quantities of olive oil are employed as elsewhere suggested. In such cases fruits may be eliminated altogether and the dietary may be made to consist exclusively of green vegetables, such as lettuce, celery, cucumbers, green corn, cabbage, carrots, turnips, and cooked greens of all sorts, spinach (parboiled), dandelion, beet tops, endive, etc. "Brose" (equal parts by measure of oatmeal, cornmeal and cooked bran) cooked for five to ten minutes may be used twice a day. Otherwise the regimen is managed exactly like the fruit regimen.

In many cases purées of sweet fruits such as bananas, dates, soaked figs or raisins, and sweet apples, pears or white cherries may be carefully added to the regimen, and later, acid fruits.

Carrots, both raw and cooked, are of special service. Metchnikoff found the stools of rabbits nearly sterile when the animals were fed on carrots.

When the Tongue Remains Coated.

In certain cases the tongue remains coated after the fruit regimen or the green regimen has been closely followed for several days. This is an indication that the normal state of the blood has not been restored. This may be due to an excessive accumulation of toxic matters in the body, or the cause may be an adherent or pouched cecum in which food residues accumulate and putrefy because the crippled cecum is not able to empty itself. In such cases the systematic use of the enema is very necessary. An enema consisting of three pints of water at a temperature of about 90° F. should be slowly introduced into the colon at bedtime. Five minutes should be occupied in getting the water into the colon, so as to give time for it to reach the cecum and thoroughly flush the head of the colon. There are sometimes adhesions of the pelvic colon which prevent efficient bowel action. In such cases a simple surgical procedure may be needed.

If necessary, repeat the enema so as to make sure that the colon is thoroughly emptied. After the warm enema, introduce a pint of cool water to restore the tone of the bowel. This prevents any possible injury from the long use of the enema. Continue this practice as long as necessary.

Disorders in Which the Fruit Regimen Is Indicated.

In high blood-pressure, whether due to degeneration of the arteries, to renal disease or to fully developed cardio-vascular-renal disease with or without dropsy, the fruit regimen is capable of rendering valuable service. The urinary acidity is high and the diminished activity of oxidation leads to a continued tendency in the direction of acidosis.

The large amount of acid salts contained in fruits in which an organic acid (citric, malic, or tartaric) is combined with potash and soda to alkalinize the tissues, or at least to neutralize the acid products present, renders this class of foods, especially juicy fruits, most useful.

Another advantage afforded by the fruit regimen in these cases is the small amount of protein present, the fruit regimen being practically a carbohydrate diet. The amount of protein present in fruits is on an average a little more than one-half of one per cent. The fruit regimen is thus practically a protein fast. If the fruit feeding is sufficiently abundant, a considerable quantity of carbohydrate will find its way into the colon and thus encourage the growth of acid-forming organisms; and even the colon bacillus and allied species, which ordinarily produce toxins, may become acid-formers, thus being transformed into protective instead of disease-producing organisms, especially with lactose feeding.

By this change of flora the production of poisons in the intestine is checked. The blood stream is no longer charged with toxic substances that irritate the delicate lining of the vessels and cause degenerative changes by which the vessels are narrowed and finally obliterated. The liver and kidneys are relieved of the great burden of distoxicating and eliminating the enormous quantities of highly active poisons which have so overtaxed their capacity that they have finally become seriously crippled. The fruit regimen, by thus eliminating the most common and active causes of vascular and renal disease, will accomplish for persons suffering from arteriosclerosis, with or without high blood-pressure, more than can be accomplished by any known drug.

The "fruit regimen" is of special service in cases of parenchymatous nephritis.

The fruit regimen is often highly successful in cases of dropsy. In dropsy there is an accumulation in the tissues of fluid charged with salt and urea. A diet free from salt has been found to be one of the most efficient means of relieving dropsy and oedema. The fruit regimen is a salt-free and almost nitrogen-free diet and hence rapidly clears the tissues of both sodium chlorid and urea.

The fruit regimen is especially adapted to the treatment of obesity. Notwithstanding the fact that a sufficient bulk of food is taken to afford the patient a sense of satiety, or to satisfy the appetite, the actual amount of nourishment is not more than half or two-thirds the maintenance ration. The result will necessarily be a steady loss of flesh.

In intestinal toxemia, which is commonly indicated by a coated tongue, bad breath and dingy or pigmented skin, very foul stools, and the other well-known symptoms of this condition, the fruit regimen is almost a panacea. In all cases in which there is no serious mechanical obstruction to bowel action present, such as adhesions of the pelvic colon, the fruit regimen may be expected to accomplish the result desired,—cases being very rare indeed in which the most sanguine expectations are not realized. Almost invariably, within three or four days after the beginning of the regimen the stools will lose their foul odor, the tongue will be found very much less coated, the breath less offensive, and in a few days more the symptoms will be very greatly ameliorated. If the regimen is followed by a rational antitoxic diet, the patient will make very rapid and satisfactory progress toward recovery. It is only necessary to manage the dietary in such a way as to keep the tongue clean and the stools free from foul odor. The bowels should move three or four times a day. So long as constipation exists, the good effects of the regimen will be manifested only in a partial way.

If the patient still continues to suffer from headache, if the tongue does not clear off, and if the foul odor of the breath and stools does not disappear after three or four days, the fruit regimen may be continued longer—if necessary, for a couple of weeks. It must be remembered, however, that the fruit regimen is partial starvation and so can not be continued indefinitely. In cases in which the full results of this diet are not obtained by the first trial, the patient may return to a more liberal diet for a few days, a week or two perhaps, when the fruit regimen may be resumed. In extreme cases the regimen may be repeated many times.

It must be remembered that the coating of the tongue is due to the growth of bacteria in the mouth which is the result of the lowered vital resistance of the whole body. This cannot be completely recovered at once; but if the stools are becoming less foul progress is certainly being made and the complete result will appear later.

In most cases of chronic disease definite indications of intestinal toxemia will be found present. While the fruit regimen will not accomplish all that needs to be done, yet it is a very good means for starting the therapeutic campaign. Where there is much emaciation the ration should not be continued for more than two or three days, after which the milk or some other fattening regimen should be employed. In cases of obesity, in myxedema with obesity, and especially in dropsical cases, the fruit regimen may be continued seven to eight days, or even two weeks.

The absence of appetite is an extremely common symptom in many cases of chronic disorders and cachexias. A patient whose tongue is coated, very often has no desire for food and the flavors of food are unattractive. After two or three days of the fruit regimen an excellent appetite is often developed. This is a highly favorable omen, for according to Pavlov's dictum, "Appetite means juice;" that is, when the patient has a good appetite and a keen relish for food, it is highly probable that the stomach is prepared to digest the food and the tissues to assimilate it.

When the tongue is coated, the fruit regimen reinforced by a liberal supply of milk sugar or lacto-dextrine is a most excellent preparation for an abdominal operation of any sort. The same regimen may be resumed soon after the operation, usually in three or four days, and aids greatly in regulating the bowels, obviating almost altogether the use of salines, castor oil, and other laxative drugs, with the exception of paraffin oil.

The fruit regimen so greatly facilitates the attainment of the results expected of the milk regimen that it serves a highly useful purpose as an introductory measure. In many cases in which the milk regimen is indicated, the patient has a coated tongue, a foul breath and is obstinately constipated. It is the writer's custom in dealing with such cases to employ the fruit regimen for three or four days before beginning with the milk. The tongue clears off, the appetite is improved, the bowels become more active, and thus the patient is prepared to take the milk with relish and to digest and utilize it.

THE MILK REGIMEN

The value of milk as a food remedy has been recognized from the most ancient times. Hippocrates especially commended it as a remedy for phthisis and for gout. He was perhaps the first to recommend the addition of water to milk (*hydrogala*) as a means of increasing its digestibility.

Aretœus, Greek physician who wrote an extended treatise on acute and chronic diseases in the second century of our era, recommended as a remedy for phthisis the free use of milk, directing that it be prepared by adding a fourth part of water and then boiling it until the mixture was reduced to one-half its original bulk.

Galen made use of cow's milk, milk of the goat and sheep, and even woman's milk. He very highly commended milk as a remedy for various diseases, and refined the method by requiring that the cow producing the milk should be fed upon certain special herbs.

The ancients evidently attributed specific healing properties to milk, which their keen powers of observation had enabled them to discover.

Hoffman especially recommended the milk of cows, fed in pastures which abounded with lotus and polygonum. As the patient improved in health, he was allowed to sail down the Tiber and use milk from the cows of Strabiœ.

Health resorts in which the milk cure was practiced existed even in those days. Each invalid was given a goat, an ass or a cow as his source of milk supply, and it was part of the duty of the patient to lead his animals to graze in pastures supposed to be best adapted to his particular case and to take the milk warm, direct from its source.

The ancients often made use of woman's milk as a remedy, and it is still used in some parts of Africa in feeding fever patients. Mr. Poultney Bigelow relates a personal experience of this sort when sick with a fever on the pest-ridden Gold Coast. This is very interesting evidence of the appreciation of the special curative properties of milk by primitive people.

Sir John Sinclair, in his "Code of Health and Longevity," mentions the use of sour milk as common in Scotland and Ireland. The milk was prepared by permitting it to sour in a vessel placed in warm water, after which the whey was turned off and the curds placed in a "plunge churn," where they were churned for some time.

Sydenham and other eminent physicians of his time made large use of milk as a remedy.

Van Swieten especially recommended milk as a remedy for gout, declaring that the victims of this disease would find themselves wholly free from pain so long as they lived upon an exclusive diet of milk.

In modern times the use of milk as an exclusive diet was brought to the attention of the profession by Philip Karell, of St. Petersburg, physician to the Emperor of Russia. A paper written by this sagacious physician was translated by Carrick, at that time physician to the British Embassy at St. Petersburg, and was published in this country in 1870.

Karell was perhaps the first to systematize the use of milk and to insist upon its use in small doses. He made use of the remedy especially in the treatment of obesity and dropsy, though he commended it in many other chronic diseases. On this account he employed small quantities, generally not exceeding three or four pints daily, the object being to reduce flesh or to promote the absorption of dropsical fluids. He said:

"I have, after fruitlessly trying all sorts of remedies in many chronic and obstinate diseases, at last succeeded in thoroughly bringing the alimentary canal, that seat of so many diseases, under my control. I did this by administering milk according to a new method."

Among the specific virtues of milk are:

1. Its richness in lime salts; an ounce of milk contains more food lime than a pound of beefsteak and nearly as much as a pound loaf of bread.

2. Richness in vitamins, supplying every sort needed by the growing animal, anti-rachitic, anti-beriberi, and anti-scor-

butic, which the cow gathers from the grass and other herbage for the use of her calf.

3. Protein of exceptional quality which is not only capable of supplying all the elements needed for repair of living cells, but is capable of supplementing the deficiencies of the "incomplete" proteins of vegetable origin.

4. A considerable proportion of lactose, a milk sugar which by its slow absorption is able to reach the colon, where it serves a most useful purpose in encouraging the growth of *B. Acidophilus*, the protective intestinal flora, thus suppressing the putrefactive processes which give rise to autointoxication.

5. The fats of milk are in a state of fine emulsion and thus well prepared for the action of the digestive juices.

Technic of the Milk Regimen.

First of all, it must be emphasized that simply feeding milk is not what is meant by the milk regimen. The difference is a vital one. Milk feeding is often a failure in cases where the milk regimen succeeds admirably.

The first essential is that the milk should be taken in large amount, so large as greatly to exceed the needs of the body, and thus fill the alimentary canal with material which will promote the growth of friendly bacteria.

A second essential is that the milk shall be taken often. A half pint every half hour is the usual plan. This makes it possible to take into the stomach the five or six quarts of fluid for one day's ration. It is also important to maintain a constant stream of fresh material passing along the alimentary canal, so that a considerable portion may reach the colon undigested and unabsorbed. It is especially desirable that a sufficient amount of milk sugar should reach the colon unabsorbed to maintain in the colon a state of acid fermentation, thereby preventing putrefaction and changing the intestinal flora. This is, indeed, in many cases the chief benefit derived from the milk diet. An important fact pointed out by Magnus-Levy is that "the absorption of the various forms of sugar in the intestine proceeds with unequal velocity. This observation, which has been made repeatedly on animals, Weinland has found to hold good for man (Nagano); maltose and dextrose disappeared completely in one hour, whereas only 26 per cent of milk sugar, present originally in equal quantity and in the same concentration as the maltose and dextrose, was absorbed during the same period."

To encourage the acid fermentation in the colon it is well to give at each alternate feeding acidophilus buttermilk in place of sweet milk; or equal parts of sweet milk and milk soured by the *B. acidophilus* may be taken at each feeding.

Milk ferments but does not putrefy. This fact has been established by Hirschler, Rovighi, Schmitz, Eisenstadt, and many other observers. The fact that milk also "arrests or diminishes intestinal putrefaction accounts for its absence in milk diet" (Czerny). As a matter of fact, however, milk may encourage putrefaction if constipation coexists. This is due to the fact that undigested curds remain in the colon after the sugar of milk has been wholly absorbed, so that its protective influence in supporting acid fermentation is lost. This makes bran or agar and paraffin oil an essential part of the "milk regimen" to insure frequent and efficient action of the colon.

Feedings begin at 7:00 A. M. and end at 7:30 P. M.—twenty-six feedings in all. At 10:00 A. M. and 4:00 P. M. the milk is omitted and a meal of fruits is taken instead. The purpose of this is to encourage bowel activity, since very free and frequent bowel movement is essential to success. The disappointing results often encountered in the use of the milk diet are chiefly due to the constipation which is likely to be produced in many persons, the natural result of which is intestinal toxemia and an aggravation of the very symptoms for which relief is sought.

Two ounces of sterilized wheat bran or an ounce and a half of agar-agar should be taken in half ounce doses, in connection with several of the milk feedings, preferably at 7:00 A. M., 11:00 A. M., 3:00 P. M. and 7:00 P. M.

In cases in which the colon is badly crippled—that is, when there is obstinate constipation—the use of the Russian paraffin oil in doses of one to three tablespoonfuls four times a day is necessary to secure the activity required for a rapid and efficient change of the flora.

When the period of exclusive milk feeding is ended, a laxative and strictly antitoxic diet must be adopted.

It should be remembered that the chief advantages of the milk regimen as a means of changing the intestinal flora lie (1) in the large amount of milk sugar that by this means is carried into the colon and there, fermenting, produces lactic acid and so prevents the growth of the putrefactive bacteria; (2) in the frequent bowel actions induced. The soft curds, undigested and unabsorbed, by their bulk as well as by their acidity, stimulate peristalsis and cause several bowel movements daily.

The bowels should move four or five times a day, the enema being used if necessary. No laxatives other than bran or agar and paraffin should be used. If proper bowel action cannot be secured by these means, the "milk regimen" must be suspended at once.

If the patient is emaciated, so that a gain in flesh is one of the objects of treatment, complete rest should be maintained during the first week—not necessarily in bed, but on a cot, or in a wheel-chair a part of the time if more agreeable.

During the resting period the patient should take a few deep breaths four or five times every hour when awake, to counteract the ill effects of lying in bed. The position should be changed occasionally. When lying on the back, a cushion should be placed at the small of the back. Sand bags are useful as "props."

The patient must spend every possible moment out of doors, day and night.

Amount of Milk to be Taken.

The amount of milk taken daily must depend upon the capacity of the patient. Much more is necessary than actually needed for nourishment. The ratio to body weight is about one and one-half ounces of milk to each pound of body weight. The following table shows the aggregate amounts for different-sized feedings:

At each feeding	*Total*
4 oz.	6 pints
4½ "	6¾ "
5 "	7½ "
5½ "	8¼ "
6 "	9 "
6½ "	9¾ "
7 "	10½ "
7½ "	11¼ "
8 "	12 "

The total food value in calories of the full regimen (6 qts.) is not far from 4,000 calories, of which one-half is fat, one-fourth casein and one-fourth milk sugar; that is, 2,000 calories of fat, 1,000 of protein, and 1,000 of carbohydrates.

The fat and milk sugar are more completely utilized than the casein. The body can store up almost any amount of sugar and fat in the form of adipose tissue and glycogen, but only a very limited amount of protein. This is especially true while the patient remains in a state of rest. Protein can not be retained unless it is utilized by entering into the composition of the living tissues of the body—the glands, nerves, blood, and muscles. Not more than two to three hundred calories per day can be used for this purpose, so that several hundred calories of casein must be lost in the stools. The loss is not complete, however, for the soft, slightly acid curds have a highly beneficial effect upon the diseased surfaces of the colon, suppressing the growth of pernicious bacteria, and gathering them up and sweeping them away by stimulating intestinal activity.

In the exceptional cases in which a larger amount of milk is needed, an extra quart may be added by giving feedings at 8:00, 8:30, 9:00 and 9:30. These extra feeding hours may also be utilized to make up the full amount needed in cases in which the patient is not able to take so much as 8 ounces at each feeding.

In very exceptional cases feedings may be given at midnight, 2:00 A. M., 4:00 A. M. and 6:00 A. M. It is better, however, in general, to allow the stomach an opportunity to rest during the night. Within about eight hours after the last feeding the stomach and small intestine should be empty of food, thus giving the digestive tube and its secreting glands an opportunity for complete rest during five or six hours. Glands, like muscles, need rest to enable them to replenish their stores of energy.

One of the chief benefits derived from the "Milk Regimen" is the change of flora which is produced by it. This requires the ingestion of 8 to 10 ounces of milk sugar. When the full six quarts of milk are taken, this amount of lactose will be assured. In many cases, the addition of three or four ounces of sugar is an advantage, and when the amount of milk is less, milk sugar must be added in proportion as the amount of milk is lessened.

How the "Milk Regimen" Differs from the "Milk Diet."

There are several important particulars in which the "milk regimen" differs from the "milk diet," or ordinary milk feeding, and these points are so important that we shall give brief attention to each one, and endeavor to make clear why the "milk regimen" may be expected to succeed in cases where the so-called "milk diet" has failed.

Cases are, indeed, very rare in which the milk regimen can not be employed with success, even though the patient's former experience may have been such as to justify the expectation of failure. About the only cases, in fact, in which the milk regimen is positively contra-indicated, are those in which the individual has been sensitized to milk protein.

The milk regimen differs from ordinary milk feeding, especially in the following particulars:

1. It is a *systematized* method. In ordinary "milk feeding," it is a common practice with physicians to say to the patient, "Take all the milk you can at meals and between meals." That is, the milk is simply added to the ordinary bill of fare. This method occasionally succeeds fairly well in securing a gain in weight when this is the chief object sought, but not infrequently, perhaps in a majority of cases, the patient soon finds his digestion upset. The appetite disappears, the bowels become inactive, the tongue coated, and pronounced symptoms of intestinal toxemia appear.

When taken in this desultory manner, milk is likely to promote rather than combat putrefaction in the colon. In cases in which a normal or excessive amount of free hydrochloric acid is produced by the stomach, large tough curds are likely to be formed, which, finding their way into the colon, furnish a favorable medium for the development of the putrefactive organisms that abound in this part of the alimentary canal. This is particularly apt to occur if the milk is taken between meals, for then it enters the stomach at a time when a large amount of highly acid gastric juice is present, a condition favorable to the production of large indigestible curds.

Intestinal putrefaction increases the constipation and resulting toxemia that destroy the appetite and give rise to malaise, headache, and other distressing symptoms. Thousands of persons have learned from experience that milk, when taken in connection with other foods, produces the disagreeable symptoms here mentioned; but when taken in sufficient quantity and as an exclusive article of diet, these symptoms do not appear, for the following reasons:

(a) The quantity of milk taken is so great that the lime and casein present neutralize the acid of the gastric juice and diminish the intensity of the action of the rennin, so that the curds formed are soft and friable and easily broken up.

(b) When milk is taken in connection with an ordinary diet, the quantity is so small and its movements along the intestine so slow that the milk sugar present is all absorbed before it reaches the colon. Thus the undigested curds present are not protected from the action of putrefactive bacteria, but are left to undergo decomposition. When taken in the quantity prescribed by the milk regimen, the whole alimentary canal is flushed with milk, in which the lactic acid fermentation begins before the colon is reached; and the movement toward the colon is so rapid that a considerable portion of the milk sugar taken reaches the colon. The twelve pounds of milk usually taken by the patient on a milk regimen contain about half a pound of milk sugar. A sufficient amount of this will reach the colon to maintain acid fermentation by which the growth of the putrefactive organisms is prevented.

Bienstock, Tissier, and Martelly have shown that when sugar is present to the extent of one per cent. putrefaction and toxemia are prevented. Careful chemical analysis of the stools of patients taking the milk regimen shows the presence of sugar to the extent of one per cent. In a case in which a fistulous opening existed in the intestine just above the ileocecal valve, the amount of lactose found present in the intestinal contents while the patient was taking the milk regimen was more than two per cent. That is the food residues of the small intestine which were just ready to enter the colon, contained an amount of sugar amply sufficient to protect the contents of the colon against the action of putrefactive bacteria.

2. The *frequency with which the milk is administered* plays a highly important part in the success of the milk regimen. Each time the milk is taken a new impetus is given to the peristaltic activity of the stomach and the intestine. Fresh food entering the stomach sets up active peristalsis the whole length of the alimentary canal. This serves an important purpose in getting a

sufficient quantity of lactose into the colon to support the active growth of acid-forming bacteria. Carmine given at the seven o'clock feeding to a patient on the milk regimen will usually make its appearance in the stool within fourteen hours, and may disappear within twenty-five hours. (Compare this time with the average figures, 53 hours).

3. Peristaltic activity is increased with the "milk regimen" and decreased with the ordinary "milk diet." When used in the ordinary way, milk is generally found to be constipating. Some persons note laxative effects from the use of buttermilk, although this is not uniformly the case. Boiled milk is almost universally regarded as constipating. There are two reasons for this:

(1) When milk is well digested, no residue is left behind to stimulate peristaltic activity.

(2). If it is not well digested, the putrefaction of the curds that pass into the colon will cause the production of ammonia and other putrefaction products, the effect of which is to paralyze the colon and produce constipation.

The older writers on the milk diet call attention to the fact that patients taking the milk cure are constipated, and even refer to the constipation as a good indication. Some modern advocates of the milk diet have expressed the same view. One writer even goes so far as to recommend that the "call" for evacuation of the bowels should be resisted and postponed so as to secure a large movement the next day! Nothing could be more absurd. The bowels should always move three times a day, and a person on the "milk regimen" should have at least four bowel movements daily. A steady stream of sour milk must pour along the intestinal canal. In this way the old flora or "meat bacilli" (Herter) and other "wild" bacteria, may be driven out and the new beneficent, acid-forming flora may be established.

The employment of special means for increasing intestinal activity has been found to be highly advantageous. It is for this reason that bran or agar-agar, with white refined paraffin oil in some form, should be employed in sufficient quantity to insure vigorous peristaltic activity. In the exceptional cases in which the bowels move too frequently the quantity of milk must be lessened.

4. It has been found decidedly advantageous to allow the patient two meals of fresh fruit, one in the forenoon, the other in the afternoon—at 10:00 A. M. and 4:00 P. M. The usual glass of

milk is omitted and the patient is allowed to take, instead, fruit of any kind for which he may have a fancy. Fresh fruits or dates are however, preferable, particularly strawberries and juicy fruits of all sorts. Great care must be taken to masticate the fruit very thoroughly. Lettuce and spinach may be added to the fruit meal without any disadvantage in most cases, and with very great advantage in some. These foods require almost no digestive activity, while they supply vegetable acids, together with carbohydrates, which aid in establishing the acid-forming bacteria in the colon, as well as vitamins, iron, and various salts that promote nutrition. The alkaline salts furnished by fruits are particularly valuable to combat the slight tendency of the milk regimen to disturb the equilibrium of the body fluids as regards the exact balance of acids and bases.

In cases of anemia, the addition of purées of spinach or other greens is important to supply food iron for the blood.

Practical Suggestions.

When a gain in flesh is one of the chief objects desired to be attained by the use of the milk regimen, the patient should take very little or no exercise during the first week. It is not necessary, however, that he stay in bed, as some have insisted, but he must avoid active exercise. Even moderate exercise may increase metabolism from twenty-five to fifty per cent. The energy thus consumed in muscular activity diverts a definite amount of nutritive material which has been digested and absorbed, and consumes instead of storing it. Generally, the patient may read, chat, and entertain himself, and may be entertained with music and in other ways, but should avoid violent excitement of all sorts and should sleep as much as possible.

Care should be taken to see that while the patient lies in bed the trunk is properly supported by a firm cushion placed at the small of the back. When this precaution is neglected, patients lying long in bed often suffer from backache due to lack of back support, and sometimes subluxation, or strain, of the sacro-iliac synchondrosis, the joint formed by the junction of the sacrum and the lateral bones of the pelvis.

It is also wise to lie with the body inclined toward the right side. This position facilitates emptying of the stomach, especially when it is dilated or prolapsed; but if nausea is present, the patient should lie upon the left side, to prevent "drag" upon the cardiac orifice (Brunton).

Sand bags weighing ten to twenty pounds are of great service in supporting the patient in a position of complete relaxation and rest. More than half the internal work of the body is due to muscle tension. Lying in bed is often far from being the complete rest that one naturally conceives it to be. The evidence of this is seen in the fact that the patient often becomes uncomfortable and requires frequent change of position. The chief cause of discomfort is undue muscle tension, due to unconscious muscular effort in maintaining the body in position. That this is considerable is shown by the instant relief and sense of comfort experienced when sand bags or other suitable "props" are properly applied.

The tendency to slip down in bed, if the head and shoulders are raised even a little, is unconsciously antagonized by involuntary muscular action involving waste of energy. This may be easily prevented by a twenty pound sand bag placed against the buttocks.

Absorption of the digested food material from the intestine may be promoted by application of pressure upon the abdomen. In the majority of cases in which the milk regimen is employed, the patient will be found to have very relaxed abdominal muscles, and in consequence the intra-abdominal pressure is greatly diminished if not altogether absent. This greatly hinders the absorption of the digested foodstuffs. By the application of a sand bag or a shot compress to the abdomen the necessary pressure may be secured and absorption thus greatly facilitated. Or, instead of applying weight to the abdomen the patient may obtain essentially the same result by lying upon the face, so that the abdomen will be compressed by the weight of the body. By lying over a cushion or a pillow the effect of the prone position may be greatly increased.

The care of the mouth is important. It should be well cleansed by rinsing with water after each feeding, and the teeth brushed and polished, preferably with the paper polisher (Hygos).

Results of the Milk Regimen.

The tongue becomes clean, the breath sweet, the stools are no longer offensive, and usually have a yellow color and little odor or a slightly sour odor. This change is generally observed within a week or ten days, and even sooner when the bowels move very freely. The skin clears, the blood improves, the patient gains in flesh, often a pound a day, and the old depression, headache, mental dullness, and other miseries are replaced by a sense of energy and well-being. The transformation of the patient from a poor, emaciated, despairing invalid to a plump, rosy cheeked, bright, forceful person is often so rapid as to seem almost miraculous.

This rejuvenating process sometimes continues for two or three months, if the regimen is faithfully carried out and modified to meet the patients changing needs. A gain of twenty-five to thirty pounds in six or eight weeks is not uncommon. Sometimes a gain of forty pounds is made in as many days. This is easily accounted for by the large amount of lactose in the ration. One ounce of sugar absorbed in addition to a full ration may cause an increase of flesh amounting to four ounces. Fats only add their own weight.

SUPPLEMENTARY FEEDING.

While, in general, eating between meals is to be discredited and condemned, supplementary feedings at stated times between regular meals are sometimes useful, particularly in cases in which the amount of food which can be taken at meals is so small that the required number of calories cannot be taken at three meals, and in cases in which it is desirable to increase the food intake to the maximum limit. Supplementary feeding is also found advantageous in cases in which the patient's stomach empties too rapidly, giving occasion for the development of annoying hunger pains. In all cases when supplementary feedings are employed, care should be taken to make sure that the food taken both at the regular meals and the supplementary meals is of such a character that it will pass out of the stomach quickly—say within an hour or two. To insure this it must be taken in the form of purées. It should be well chewed, whether mastication seems necessary or not, and should contain little fat. Fats pass from the stomach very slowly and on this account fats are not suited to supplementary feeding.

Among the foodstuffs best adapted to supplementary feeding are juicy fruits and fruit juices. The list of fruits should not include, however, such substantial foods as dates, figs, raisins or bananas. Peaches, apricots, plums, apples, pears, melons of all sorts (rejecting the pulp), may be taken at any time when the stomach is not already filled with food. Such foodstuffs require practically no work on the part of the digestive organs. Almost their sole nutritive constituents are acids and sugars. These are ready for immediate absorption and furnish to the heart and other muscular structures material ready to be utilized at once. Malt sugar also requires little digestive work to prepare it for immediate assimilation.

Milk sugar may also be employed for supplementary feeding with advantage in cases in which it is desirable to change the intestinal flora.

Whey is another supplementary food of value. Rice jelly and agar jelly prepared with fruit juices, also fruit ices, may be employed in this way. Ices and all cool foods should be eaten very slowly, so as to avoid disturbing digestion by the chilling of the stomach.

It is useful to bear in mind that the food value of an ounce of sugar is about 100 calories. An ounce of dry starch or flour has practically the same value. An ounce of grape juice has a caloric value of one-fourth as much, an ounce of whey 8 calories, an ounce of tomato broth 3 calories.

By means of supplementary feedings, especially by the use of malt sugar and milk sugar, it is easy to introduce 800 or even a thousand calories of food in addition to the regular meals, thus securing a rapid gain in flesh.

Vegetable broths, such as Savora broth, bean broth, tomato broth and a broth prepared from the unripe soy bean (Hahto or Easy Cook), are excellent for supplementary feedings when the desire is to increase the supply of vitamins and organic salts. When taken with the regular meals these bulky liquid foods fill up the stomach and prevent the patient from taking the needed quantity of proteins, fats and carbohydrates. Egg-nog, beef juice, beef tea, animal broths, bread and milk, bread and butter, sandwiches, cake, pie, and similar foods, and all solid foodstuffs, are wholly unsuited for supplementary feedings.

METHOD OF CHANGING THE INTESTINAL FLORA

The intestinal "flora" is the bacterial vegetation of the intestine, just as the flora of a country consists of the plants—trees, shrubs, weeds, flowers, mosses, and other growths which its soil produces.

Why the Intestinal Flora Needs to be Changed.

When a physician is called to attend a young infant, one of his first inquiries is respecting the character of the stools. The well trained nurse always has the infant's napkin ready for exhibition when the doctor is expected.

A normal infant's stool is yellow in color, soft in consistency, and nearly odorless or perhaps of a slightly sour odor.

If the stool is dark in color and putrid, ammonical, rancid, or otherwise foul smelling, no other evidence is needed that the child is ill and suffering from the absorption from the colon of putrefactive products, the result of intestinal stasis.

Careful examination of the stools is as important in the treatment of adults as of infants. The significance of a dark colored, putrid, strong-smelling stool is essentially the same whether the patient is an adult or an infant. Such a stool means colonic stasis or delay in the colon and the putrefaction of the colon contents, with the absorption of the products of putrefaction and resulting toxemia. All physiologists agree that, normally, there is no putrefaction in the human intestine. Only when delay occurs is there opportunity for putrefaction. Putrefaction is, for the most part, due to the development of spore-forming organisms which require an incubation period, so that twenty-four hours or more are required for the development of active putrefaction in a freshly inoculated medium.

The food leaves the stomach in about four hours after it is eaten, and in four hours more the food residues have completely passed out of the small intestine and have reached the transverse colon; the process of digestion is completed and the utilizable portions have been absorbed. There is nothing left but unusable residues and excretory products and body wastes which ought to be dismissed from the body in six or eight hours more, or in less than twenty-four hours from the time the food was eaten. This is what takes place when the normal intestinal rhythm is maintained; that is, when three complete bowel movements occur daily.

When the bowels move but once a day, the motility period of the alimentary canal is fifty to fifty-four hours, often longer. In quite a large percentage of cases, the stasis is not confined to the colon. Because of incompetency of the ileocecal valve, the stasis may extend to the small intestine and even the stomach.

Savages and the big apes move their bowels three times a day and escape intestinal toxemia; but among civilized people a faulty diet, lack of exercise, bad postures, neglect to attend promptly and regularly to the evacuation of the bowels, the use of laxative drugs, mineral waters and other disturbing influences and conditions connected with modern life, have made constipation almost universal, and as a result, chronic intestinal toxemia and a host of chronic ills growing out of this condition, including premature senility, have likewise become nearly universal.

As a natural consequence of chronic stasis, the flora of the adult colon is entirely different from that of the infant. The flora of the healthy nursing infant consists almost wholly of acid-forming organisms, especially the *B. bifidus* and the *B. acidophilus* pointed out by Dr. Tissier of the Pasteur Institute, many years ago.

The flora of the average adult living on a mixed diet is largely made up of putrefactive organisms, the *B. Welchii, B. putrificus,* with *B. coli* and *streptococci.* The same sort of flora, as Torrey and Distaso have pointed out, is found in the dog and for the reason that the diets of the dog and of man are much alike.

Poehl, of St. Petersburg, was the first to call attention to the remarkable influence of diet upon the intestinal flora. He noted that a diet of buttermilk quickly caused the disappearance of putrid stools in children.

Tissier later called attention to the antagonism between lactic-acid-forming organisms and bacteria which produce putrefaction.

Bienstock showed that the *B. coli* produces harmless acids instead of toxins, when abundantly supplied with carbohydrates.

Sittler showed some years ago that when infants were fed maltose and dextrin in the form of malt soup, *B. acidophilus* appeared in the stools in abundance.

The notable work of Herter and Kendall, published in 1910, and the more recent work of Torrey, Rettger and others, have clearly demonstrated the readiness with which the intestinal flora may be changed by controlling the diet. Indeed, experiments by Metchnikoff and extensive clinical observations by Combe had previously established the same fact.

The writer became interested in the question of suppressing intestinal putrefactions nearly thirty years ago, when Metchnikoff first called attention to the pernicious influence of colon bacteria upon health and longevity. Beginning some twenty-eight years ago, I employed with a considerable measure of success, cultures prepared from sterilized milk with various lactic-acid-forming organisms which I obtained for the purpose from Professor Conn of the Connecticut Agricultural Experiment Station.

Some twenty years ago, the idea occurred to me that if buttermilk rendered service when taken in at the upper end of the alimentary canal, it ought to render still greater service if applied directly to the colon, where its services are most required. I accordingly began the use of buttermilk enemas in cases of colitis, and with results which were almost startling. Even in very chronic cases, all symptoms of disease not infrequently disappeared within a few weeks. I found the method somewhat inconvenient, however, on account of the enormous quantities of gas sometimes produced in the colon, which gave the patient much distress.

Some ten years ago (1911), I had an opportunity to spend a few weeks in the laboratory of Dr. Distaso, at the Royal Institute of Public Health, London. Dr. Distaso was at this time making a study of the intestinal flora in persons upon whom Sir Arbuthnot Lane had operated for short-circuiting or removing the colon. I had at the same time an opportunity to observe the operative work of Lane and the immediate and remote results, as seen in his clinic. I became convinced that for a thorough-going change of the intestinal flora, it was necessary not only to implant protective cultures in large quantities, but to make a radical and permanent change in the dietary, eliminating foodstuffs calculated to promote putrefaction; and lastly, perhaps most important of all, to increase the motility of the intestinal tract so as to dispose of the food residues and body wastes so rapidly as to leave no time for the development of putrefactive changes.

Upon returning home, I established a plan of treatment in which these three factors were combined, namely:

1. A radical change of diet, eliminating putrescible material and supplying carbohydrates in form suitable to reach the colon (raw starch, dextrine and later lactose).

2. Increased intestinal activity, so as to secure three bowel movements a day by the combined use of bran or agar and mineral oil.

3. Flushing the alimentary canal with an active whey culture of acid-forming organisms. (*B. bifidus* and later *acidophilus*), by the administration by mouth of a half pint to a pint of whey culture, and the injection of a similar amount of culture into the colon after administering a warm enema.

I at once began to get more definite and reliable results than before. This method has now been extensively used at the Battle Creek Sanitarium for ten years, and has been employed in thousands of cases with excellent success.

The intestinal flora may be favorably influenced by any one of these three measures, but for definite and rapid change of the flora, all three of the methods must be employed simultaneously. We will consider each of the three distinct methods.

1. The Low Protein Diet.

It is a matter of common observation that carbohydrates (starches and sugars) ferment, while proteins putrefy. Although both changes are due to bacterial action, there is a most important difference between the classes of microorganisms involved in the two processes. The organisms that give rise to fermentation produce acids—chiefly lactic or acetic—that are harmful only in very large quantities. In the minute quantities in which they can be produced in the intestine they are usually entirely harmless. On the other hand, the microbes that give rise to putrefaction produce deadly poisons and toxins which are highly injurious in very minute quantities, some of them rivaling the venoms of reptiles in their virulence.

Bacteria, like other plants, require soils favorable for their development. It is evident that the most effective way of suppressing the growth of poison-forming organisms in the intestine is to reduce to a minimum the amount of protein in the diet.

The marked difference in the character of the stools of a vegetable-eating animal like the sheep, and those of a carnivorous animal, like the dog, is clear evidence of the influence of a high protein diet in promoting putrefactive changes in the intestine. The same difference is observed between the stools of a flesh-eating man and those of a flesh abstainer. When meat and eggs are eaten freely, considerable of the proteins escape digestion and find their way into the colon, and there undergo putrefactive changes. If, on the other hand, the protein of the diet is reduced to a minimum, so that the protein residues that reach the colon are small in quantity, the putrefactive changes are slight and the number of bacteria, with their toxins and endotoxins is notably lessened.

By a change of diet it is not only possible to change the bacterial vegetation of the intestine, but also to change the action and the nature and influence of the colon bacillus and its congeners so that they no longer produce pernicious effects, but actually become a means of protection and defense. In other words, the wild bacteria that, in various ways, as already pointed out, find their way into the human intestine and give rise to putrefaction and other bacterial changes whereby poisons in large quantities are produced, may be either eliminated or changed to harmless acid formers. The researches of Bienstock and Kendall have shown beyond question that these poison-forming bacteria cease to produce poisons when they are adequately supplied with carbohydrates of a kind that they can utilize. Kendall found that even most virulent disease-producing bacteria, like the diphtheria bacillus, in the presence of sugar cease to produce toxins. The same is found to be true of the colon bacillus and of other pernicious organisms that grow in the human intestines.

How to get the required amount of carbohydrates into the colon is the problem. Cane or malt sugar and cooked starch are so quickly digested and so completely absorbed in the small intestine that it is by no means easy to get any amount of them into the colon. Raw starch digests less quickly, and milk sugar is much more slowly absorbed than other sugars. Practically only three carbohydrates can be made to reach the colon without undergoing digestion and absorption—raw starch, dextrin and milk sugar. Raw starch digests so slowly that when taken freely considerable quantities will reach the colon and there be acted upon by amylolytic bacteria which are always present; sugar is thus produced, supplying to the colon bacillus and other harmful bacteria the material necessary for changing the action of these organisms, so that they become protective instead of destructive, through the harmless acids which they produce.

Sugar of milk in considerable quantities (3 oz. three times a day) in connection with means for stimulating intestinal activity may also be made to reach the colon because of the great slowness with which it is digested and absorbed in adults. Milk sugar remains four times as long in the alimentary canal as does malt sugar. By means of the "milk regimen," it is possible to introduce lactose or milk sugar into the colon in almost any desired quantity. Milk sugar and dextrine may be injected directly into the colon.

When the colon is thus supplied with carbohydrates, fermentation takes the place of putrefaction and the acids produced act as normal stimulants to the colon, encouraging its frequent and normal emptying.

The Milk Regimen always changes the intestinal flora, which is, in many cases, no doubt, the chief benefit derived from its use.

Combe, a recognized authority in the treatment of autointoxication, nearly twenty years ago laid down the following among other rules in relation to diet.

"*Nitrogenous foods*: 1. Diminish as much as possible the nitrogenous foods from which the intestinal bacteria derive their nourishment. 2. Absolutely prohibit those nitrogenous foods (meats) that are favorable media for the development of bacteria and form veritable culture bouillons. 3. Select eggs as being less putrefactive in the intestine.

"*Fatty foods*: 1. Avoid the fats of meat for they increase putrefaction. 2. Give fresh butter in preference to meat fat, for its action is much less harmful.

"*Farinaceous foods*: 1. Introduce into the diet as large a proportion of farinaceous substances as possible. But to obtain a result *it is necessary to saturate the intestine with carbohydrates.* The word 'saturate' is used because it is not sufficient simply to add a few farinaceous substances to the diet. *The patient must be filled with farinaceous aliments.*

"2. In autointoxication from acute enteritis, or in the acute recurrences, an exclusive farinaceous diet must be maintained for several days, for it plays the same part in acute enteritis that a liquid diet does in acute catarrh."

Chalmers Watson requires that meat shall be excluded from the diet in cases of autointoxication. It is, of course, impossible to change the intestinal flora so long as one is daily sending into his intestine billions of the very same microorganisms to which the autointoxication is due.

Wegele places first among the list of causes of autointoxication the use of meat; that is, a diet which encourages putrefaction in the intestine, both by the introduction of material which readily undergoes putrefaction and with it *B. Welchii* and other germs which give rise to putrefaction.

Tissier of the Pasteur Institute requires his patients to adhere closely to a strict non-flesh dietary. Writing me in 1911, Professor Tissier said:

"You know that all our efforts have been in the direction of preventing intestinal putrefaction, the predisposing cause of intestinal infection, and sometimes the determining cause of digestive and nervous disorders. To prevent intestinal putrefaction, we introduce as much sugar as possible into the intestine, and certain microbes ferment these sugars and thus produce acids. The acid produces arrest of the bacteria of putrefaction. But sugar is rapidly absorbed by the mucous membrane of the stomach and intestines. It does not reach the large intestine. The sugar that goes the farthest is that of the date, which can be recovered in the cecum. Of all the hydro-carbons, starch alone arrives in the large intestine, where it is decomposed and absorbed by the mucous membrane. We may increase the quantity of the sugar produced, and thanks to the ferments which produce acids from sugar, for instance the bifidus and lactic-forming bacilli, putrefaction may be arrested more quickly."

Results of Recent Experiments.

These views have been abundantly verified by clinical experience, and are fully sustained by recent researches, conducted by Drs. Torrey, Rettger and others, as well as by the writer.

In an extended series of bacteriological studies of the stools of dogs under various conditions by Torrey, the results of which were published in the *Journal of Medical Research*, it was shown that lactose and dextrin have a very marked effect in modifying the character of the intestinal flora. When lactose or dextrin were given in sufficient amount, putrefactive bacteria almost entirely disappeared, the lactic acid-forming bacteria, particularly the bacillus acidophilus, taking their place. Similar but less marked results were obtained by the use of cane sugar.

Better results were obtained with boiled milk than with unboiled. With the latter the bacillus coli predominated. Potatoes, bread, and beans, when freely used, tended to lessen the putrefactive bacteria, while meats "markedly encouraged the growth and activity of putrefactive bacteria." The casein of milk produced less tendency to putrefaction than did meat. Vegetable proteins "did not offer the slightest encouragement to the growth of intestinal putrefactive types of bacteria."

According to Rettger, "lactose, milk and mixed grains (wheat, oats, etc.) are specific articles of diet which exert an influence on the intestinal bacteria. Lactose, when fed in sufficient quantities (2 or 3 gm. daily), brings about complete transformation of the flora of white rats within three or four days; milk requires a longer time, and does not bring about a complete change. Milk and lactose together form the most practical and effective diet, at least for man. Grain feeds tend to increase the number of aciduric bacteria, but their influence is comparatively small.

"Meat or other high protein diet increases the indol-producing bacteria and other organisms of the so-called 'putrefactive' type, like B. coli and B. *Welchii.*

"The marked influence of a high lactose diet upon the intestinal flora of man, which was demonstrated in these experiments, has been confirmed by other investigators working with typhoid patients, who found that eating milk sugar (250 to 300 gm., 8 to 10 ounces, daily) brought about a marked change in the intestinal flora where the initial flora has been of a distinctly putrefactive type."

The above observations show beyond room for doubt the importance of supplying to the colon the carbohydrate necessary for promoting the growth of acid-forming bacteria. The only way in which this can be done is by proper regulation of the diet and increasing peristaltic activity. The regimen must supply forms of carbohydrate which will be slowly absorbed so that some of it may have a chance to reach the colon.

Milk Sugar and Lacto-Dextrin.

With the fruit regimen, 9 ounces of milk sugar, or dextrin, are given daily, the amount found necessary for producing the change of the colon flora. The milk sugar is given dissolved in plain water, lemonade, or fruit juice of some sort, in doses of three ounces, three times a day. Dextrin in equal quantity may be used in place of milk sugar. A specially prepared lacto-dextrin is preferable for this purpose as the ordinary dextrin of the drug stores has a very unpleasant flavor and is difficult to take. Milk sugar in large amount causes nausea in some cases, while lacto-dextrin may be taken as easily as any breakfast food.

With the fruit regimen, also, the action of the intestine is hastened, and a sufficient amount of starch and fruit sugar reaches the colon to produce the needed acid fermentation. In the after-diet, "brose," or half-cooked cereals, supplies the raw starch needed to feed the sugar-forming and acid-forming bacteria and to secure normal bowel action and arrest of putrefaction in the colon and of chronic intestinal toxemia which results therefrom.

2. Increased Intestinal Activity.

The multiplication of bacteria in the intestine is more actively encouraged by stasis or stagnation of the intestinal contents than by any other factor aside from an excessive amount of protein in the dietary. A most important means of lessening the multiplication of bacteria in the intestine is acceleration of the movement of the food residues along the intestinal tract. Delay of the intestinal contents at any point along the twenty-seven feet of small and large intestine is quickly followed by the development of active bacterial changes. While active digestion is taking place, putrefaction and fermentation are restrained. When the several digestive cycles have been completed, fermentation or putrefaction becomes active—the nature of the process being determined by the dominant character of the food residues. If these are chiefly carbohydrates, fermentation results; if protein, putrefaction.

Normally, the stomach becomes empty in about four hours after the beginning of a meal and the small intestine discharges the last remainders of the meal into the large intestine four hours later. In other words, the process of digesting and absorbing a meal normally occupies about eight hours. Three or four hours later, in the case of a perfectly normal person, the undigested residues of foodstuffs, mixed with excretory substances derived from the liver and mucous membrane, may be discharged from the body. Under such circumstances, the opportunity for putrefactive changes is so slight that the bacteria developed are comparatively few, and the amount of poisons produced is accordingly small. In carnivorous animals, the time required for the transit of foodstuffs through the alimentary canal is much shorter. Results of experimental researches published by the United States government show that the time elapsing between the taking of food and the discharge of the unused residues is, in the barnyard fowl, only three and one-half hours. In the fruit-eating bat of South America, the time is only one hour, and the feces have the odor of bananas, upon which these bats feed. The alimentary tube of the sheep is twenty-six times the length of the animal's body and the time of transit is necessarily considerably longer. Metchnikoff many years ago showed by extended researches that those animals live longest that have the shortest colons. Some animals, such as the eagle, which live on an exclusively flesh diet, nevertheless live to a great age because of the extreme shortness of the alimentary tube, which affords no opportunity for stasis and hence little chance for putrefactive changes.

It must be clearly understood, however, that by increased frequency of bowel movement is meant, not simply one bowel movement a day, but at least three full bowel evacuations. In many cases, it is desirable that as many as four evacuations should be secured. Briefly stated, my reasons for this belief are these:

In healthy infants, the bowels usually move soon after feeding. The same is true of healthy animals and active, healthy boys and girls who are fed upon a natural diet that is sufficiently bulky to produce normal peristalsis.

The savage moves his bowels three times a day, as does also the Turk. Said a Bushman to a missionary doctor whom he consulted for relief: "Doctor, I am horribly constipated; my bowels move only once a day."

The chimpanzees and other big apes in zoological gardens move their bowels four to six times a day.

It is usually quite easy by the methodical use of simple means to acquire the habit of three bowel movements daily and the results of this practice have always been found to be beneficial and in no way harmful. The method is quite simple. It is only necessary to supply the proper amount of bulk and lubrication required in each individual case. (See page 580).

3. The Displacement of Harmful, Putrefactive Bacteria by Harmless Acid-forming Organisms.

According to Burnet, the idea of supplanting the putrefactive bacteria present in intestinal toxemia by beneficent acid-formers originated with Quincke.

By extensive experiments conducted under the supervision of the writer in the bacteriological laboratory of the Battle Creek Sanitarium, it has been demonstrated that when boiled or even slightly cooked starch is present to the extent of two per cent. the growth and activity of putrefactive organisms in the feces are controlled; acids are produced in place of ammonia, and fermentation predominates over putrefaction. The same is true when milk sugar, dextrin or lacto-dextrin, is taken in sufficient amount; that is, three ounces three times a day (Torrey).

The principal battle waged between beneficent and pernicious bacteria in the intestine is, according to Burnet, between *B. Welchii* on the one hand and *B. acidophilus* and *B. bifidus* on the other.

Those bacteria that produce the largest amount of acids are most active in resisting the growth of putrefactive organisms. The *B. bifidus* and the *B. acidophilus* cease to grow only in solutions containing five per cent. of acid, while *B. Welchii* is inhibited by an acid solution of the strength of one-sixth of one per cent.

When on a visit to Europe several years ago (1907), the writer secured cultures of *B. bulgaricus* from the Pasteur Institute. For the purpose of making a crucial test of the ability of the *B. bulgaricus* to suppress putrefaction, a beefsteak was put into a culture of the bacillus. Although the flesh was slightly tainted when purchased, after a few days in the buttermilk it was found to be entirely free from taint. This experiment after thirteen years is still in progress. The beefsteak remains absolutely free from any putrefactive change. Bacteriological examination shows no putrefactive bacteria present. The flesh has the appearance of fresh meat made a little paler than usual by the long continued maceration to which it has been subjected.

This method of preserving meat was practiced by the pioneer women of our Western frontier, who often kept fresh meat for several weeks by immersing it in pans of sour milk. I learned recently from a gentleman who has traveled extensively in the

East that a similar practice is also in vogue among the Arabs, who preserve their fresh meat in camel's milk.

The *B. acidophilus* seems to be a strain or variety of the *B. Bulgaricus* which has become acclimated to the human colon and able to thrive there so long as it is supplied with the necessary carbohydrate.

The philosophy of this method is exceedingly simple. The *B. acidophilus*, introduced with the food, finds its way into the colon and there produces lactic acid and so develops a condition unfavorable to the growth of putrefactive bacteria, which do not thrive in an acid medium. Rettger thinks that it is the carbohydrate rather than the acid which hinders the growth of the putrefactive bacteria.

Two conditions are necessary for the success of this method:

1. The *B. acidophilus* must reach the colon in sufficient numbers to be able to produce a sufficient amount of lactic acid to acidify the colon's contents.

2. It is necessary that the *B. acidophilus* shall find in the colon the food necessary for its sustenance and by the aid of which alone it is able to produce lactic acid, viz., carbohydrate.

Unfortunately, both of these conditions are somewhat difficult to secure. The *B. acidophilus* is likely to be destroyed by the digestive fluids on its way to the colon, while the sugar which is essential for its development is almost certain to be absorbed in the small intestine, so that the acid-forming bacilli speedily starve to death after reaching the colon, for lack of suitable nourishment.

It is necessary that large quantities of very active cultures should be taken and special measures must be adopted to supply to the *B. acidophilus* when in the colon the carbohydrate which it requires for efficient growth.

One way of accomplishing this is by the administration of freshly prepared acidophilus buttermilk in connection with the milk regimen. It may also be accomplished by giving fresh whey cultures of the *B. acidophilus in* massive quantities, or large doses of *Acidophilus-Lactose*, a concentrated culture. The last named method has proved most efficient.

The *B. acidophilus* is probably always present in the intestine, but generally in such small numbers that it is overwhelmed by the putrefactive bacteria.

By the administration of three ounces of milk sugar or dextrin three times, daily, the *bacillus acidophilus* will increase in numbers, and by the end of a week or ten days may be obtained from the stools in almost pure culture. The Welch's bacillus and other putrefactive and injurious organisms will be found to have disappeared. By adherence to an antitoxic dietary, an occasional return to the milk sugar feeding, or the liberal use of the *B. acidophilus* culture, the putrefactive flora of the intestine may be held in abeyance and the colon kept free from putrefaction.

Fuld (*Deut. Med. Woch*), mentions a method which has been tried for changing the intestinal flora by injecting into the colon cultures of colon bacilli. This method has been extensively exploited in this country, but cannot be regarded as other than irrational and utterly incapable of securing any definitely beneficial results.

The writer has for some years made use of colon injections of cultures of the *B. Bulgaricus* and *B. acidophilus* as a means of changing the flora in connection with a special dietary, such as the fruit or milk regimen, and with very great success. Many hundreds of cases of colitis have been cured, and the method has now been adopted in many other clinics. The colon is daily washed out with a hot enema (105°F.) and afterwards an ounce of Acidophilus-Lactose is introduced, dissolved in a pint of thin starch water at a temperature of 100°F. In very chronic cases of colitis, the colon treatment must be continued for several weeks in some cases.

In a recent work by Rettger and Cheplin it is held that the flora may be changed by the use of lactose or dextrine or by the use of acidophilus milk in liberal quantities without any other change in diet. The writer is convinced that this method will often fail to make a satisfactory change of the flora in cases in which the colon is badly crippled and especially when there is marked stasis in the small intestine. The delay in the intestine permits absorption of the lactose before it reaches the colon, where its services are especially needed.

Rettger and Cheplin also note that after the flora has been changed by means of lactose or acidophilus milk, the objectionable "mixed flora" reappears in less than a week after the lactose or culture is discontinued. Obviously there is little use in changing the flora unless the change is maintained. By combining the use of lactose and acidophilus with the fruit regimen or the milk regimen, the change may be accomplished more quickly and certainly than by either plan alone. To prevent return of the flora to the mixed type, meats of all sorts must be discarded from the dietary and the colon must be evacuated three times a day. (See p. 580).

When the cecum is adherent, the descending colon spastic, the pelvic colon prolapsed and adherent or impacted, the change of flora is more difficult of accomplishment because of the delay of residues whereby opportunity is given for the absorption of the lactose, permitting the development of the putrefactive organisms. In such cases, the colon must be emptied thoroughly by an enema daily, or even twice a day. By a persevering effort and the use of larger quantities of lactose or *Acidophilus-Lactose* (4 oz. three times daily,) the change will finally be accomplished, although the time required may be sometimes so long as two or three weeks.

In chronic cases of toxemia, the change of flora should be repeated every four to six weeks for some months.

With lactose feeding, as with the milk regimen, there is not infrequently at first a very marked looseness of the bowels, due, possibly to the temporary increased development of the Welch's bacillus. A lessening of the dose to one ounce three times a day will usually correct the looseness at once, and then the smaller dose may be taken, and as the flora is changed, the tendency to diarrhea will disappear.

The first effect of large doses of dextrin or lactose, is greatly to increase gas production. This inconvenience will disappear in a few days, as soon as the Welch's bacillus and the colon bacillus have been greatly reduced in numbers. The disappearance of putridity of the stools and of gas are an indication that the change of flora has taken place, and with this change the production of colon poisons and the mischiefs which they produced will have ceased.

The Body's Defenses Against Bacteria and Toxins.

To fully appreciate the importance of changing the intestinal flora and adopting the antiseptic diet, it is necessary to have in mind the several methods and mechanisms by which the body defends itself against germs and germ poisons, the chief of which are the following:—

1. The acid of the gastric juice, which disinfects the food.
2. The bile, which neutralizes germ poisons and hinders the growth of bacteria.

3. The ileocecal valve, which prevents the backing up of putrid matters into the small intestine and thus hinders their absorption.

4. The filtering power of the mucous membrane of the colon by which certain poisons are excluded, while others are destroyed.

5. The liver, which retains certain poisons, destroys others, distoxicates others, and removes still others from the blood.

6. The excretion of poisons by the stomach, whereby the toxic substances are temporarily removed from the circulation.

7. The thyroid and pituitary glands, which aid in the destruction of poisons.

8. The suprarenal capsules, which destroy poisonous pigments.

9. The kidneys, which remove poisons, especially acids.

10. The mucous membrane of the lungs which eliminates gaseous poisons.

11. The blood, the white cells of which destroy germs, while its enzymes and antibodies combat the development of germs and destroy their poisons.

12. The skin, which eliminates poisons.

In all cases in which the defenses of the body are damaged, the antitoxic dietary is absolutely essential and should be most carefully followed.

Diseases in Which the Intestinal Flora must be Changed.

Among the maladies in which the defensive mechanisms of the body are crippled may be mentioned especially the following:

Achylia, gastric ulcer, cancer of the stomach, duodenal ulcer, inflammation of the gallbladder, gallstones, abscess of the liver. cirrhosis of the liver, pancreatitis, diabetes, exophthalmic goiter, toxic goiter, cystic goiter, myxedema, Addison's disease, Bright's disease, pyonephrosis, arteriosclerosis, jaundice, syphilis, multiple neuritis, intestinal toxemia, dementia praecox, manic depressive, toxic neurasthenia, eczema, acne, degenerative disorders of the nervous system, pernicious anemia, splenic anemia, cancer in any part of the body, *chronic appendicitis, chronic bronchitis, bronchial asthma, cardiac asthma, migraine,* or so-called *sick headache,* so-called *biliousness* or *torpid liver, acidosis, apoplexy, osteo-arthritis* or *chronic rheumatism, chorea, colitis, chronic diarrhea, premature old age, sprue, pellagra, fever.*

Sir Arbuthnot Lane enumerates the following symptoms and conditions as due to intestinal toxemia, in all which the antitoxic diet is necessary:

"Wrinkles, atrophy of the skin, pigmentation of the skin, browning of the eyelids, also the skin about the eyes, the axillae, the abdomen, cyanosis, coldness of the hands and feet, sweating of the hands and feet, livid skin, roughness and dryness of the skin, wasting of the muscles, general muscular weakness, curvature of the spine, wasting of the abdominal muscles, prolapse of the viscera, weakness of the heart, degeneration of the aorta, dilated heart, melancholia, imbecility, headache, symptoms resembling brain tumor, epilepsy, diseased conditions of the mammary gland—a nodulated condition, induration, cystic degeneration and later cancer, goiter, adenoids, enlarged tonsils—the result of lowered vital resistance, pyorrhea, endometritis, uterine cancer, various diseases of the eye and baldness. In certain persons increased growth of the fine hairs covering the general surface of the body, tuberculosis, rheumatoid arthritis."

In all the above conditions a change of flora is most positively indicated. It is not always possible to accomplish this easily, although in the majority of cases a well directed effort will show definite results within three or four days. The best means is the fruit regimen already described in preceding pages. This should be used for three to five days, after which the antitoxic regimen should be definitely and permanently adopted and scrupulously followed. A departure from a strict antitoxic diet may often be followed by relapse within a short time. It must be constantly borne in mind that disorders and symptoms such as above described do not appear until after some essential part of the defensive mechanism of the body has been broken down, so that dietetic digressions which produced no apparent effect when the body defenses were intact, even when indulged to an immoderate degree, become disastrous even when the departure from a strict antitoxic regimen is comparatively slight. It must be remembered, also, that when the results or intestinal toxemia have become well developed and have existed for a considerable length of time, the damage to the defensive mechanism has become so serious that it is probably to a considerable degree irreparable, and for this reason relief from the existing disorders can only be secured by a thorough change of flora and the most exemplary following of a carefully arranged antitoxic regimen with no digressions.

When the kidneys have been badly damaged, as shown by the presence in the blood of an abnormal amount of non-protein nitrogen, the protein of the diet must be kept down to the very lowest limit and should never exceed one calory per pound of body weight. In many cases the protein may be with benefit reduced to half this amount for periods of a few days at intervals, and in extreme cases it is desirable to eliminate the protein from the bill of fare entirely for short periods so as to make the work of the kidneys as light as possible.

In chronic cases of intestinal toxemia it is often necessary to repeat the special regimen for changing the flora (fruit regimen) at intervals of a week or two for some time in order to secure a radical change in the intestinal flora, and the fruit regimen with lactose and acidophilus cultures should be returned to whenever the putrid odor of the stools reappears.

THE ANTITOXIC DIET

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According to Herodotus, who wrote in the fifth century, B. C., being one of the earliest of all historians, the early Egyptians recognized the importance of maintaining the activity of the colon. He says, "For three successive days in each month they purge, hunting after health with emetics and clysters, and they think that all the diseases which exist are produced in men by the food on which they live; for the Egyptians are from other causes also the most healthy of all men next after the Libyans."

The fact that the Egyptians recognized, as shown by the above paragraph, the pernicious influence of constipation as a cause of disease indicates the great advancement they had made in the knowledge of hygiene, as shown also by their numerous sanitary regulations, many of which were incorporated into the code of laws formulated by Moses for the Israelites while they were wandering in the wilderness.

Bouchard taught us that the body is a factory of poisons. Besides those which it normally produces, the colon, when infected, produces a long list of disgusting putrefaction products which are absorbed and often overwhelm the poison-destroying and poison-eliminating mechanisms of the body to such a degree as to interfere seriously with the ordinary life processes. This condition is termed autointoxication or intestinal toxemia, or alimentary toxemia, and is the predisposing or exciting cause of most chronic and many acute maladies.

The antitoxic dietary has five essential characteristics.

1. It must be laxative so as to prevent stagnation in the colon, thus giving the residues and wastes no opportunity for putrefaction.

2. It must be free from putrefaction products and from the bacteria which produces putrefaction and the resulting poisonous products.

3. It should be poor in substances capable of undergoing putrefaction; that is, it must be low in protein.

4. It should be rich in carbohydrates which encourage the growth of protective bacteria in the intestine.

5. For the greatest efficiency it must include considerable raw starch or other carbohydrates such as lactose or dextrin which are absorbed with sufficient slowness to permit them to reach the colon and thus furnish food for the protective bacteria which, by encouraging fermentation in the colon, prevent putrefactive changes, thus cutting off the scource of the toxins which give rise to intestinal toxemia.

In arranging an antitoxic bill of fare:

1. Meats of all kinds, including fish, flesh, fowl, and shellfish, together with many varieties of cheese, as Limburger and Roquefort, must be wholly discarded.

2. Eggs must be used sparingly. The yolks of eggs may be eaten more freely than the whites. Raw whites must be wholly discarded. It has been demonstrated that the raw white of egg is not well digested in the human intestine. The yolks of eggs, even when hard boiled, are quickly and very completely digested. Hard boiled whites of eggs often pass through the alimentary canal without digestion. The greatest care must be taken to avoid the use of eggs which are not perfectly fresh. Eggs are likely to be infected even under most favorable conditions. Dr. Rettger, of Yale University, has shown that about one egg in seven contains bacteria when it is laid. These bacteria will escape destruction unless the egg is well cooked. When freely used eggs promote intestinal putrefactions.

3. In some persons milk produces such decidedly toxic effects it must be avoided. The ill effects are shown by coating of the tongue, loss of appetite, headache, and often constipation. The symptoms may be due to a special sensitivity against milk.

They may also result from toxemia arising from the putrefaction of undigested curds in the colon. It should be noted, however, that milk, is shown by Tissier, Torrey and others, is much less likely to encourage putrefactive changes in the colon than is either meat or eggs. Buttermilk has some merit as an antitoxic diet if properly prepared and used in sufficient quantity. Three or four pints of acidophilus buttermilk taken daily will produce within a week a very marked change in the character of the intestinal flora.

4. Greens and such coarse vegetables as turnips, carrots, parsnips, celery, lettuce, cabbage, etc., should be freely used together with bran and coarse cereals. Fine flour bread and other superfine cereal products should be avoided. Polished rice may be used, but only in connection with the coarser foods mentioned. A liberal supply of roughage should constitute a portion of every meal.

5. Certain vegetables, such as carrots, seem to possess a special antitoxic value, discouraging the growth of bacteria probably by carrying a considerable amount of undigested starch into the colon. Metchnikoff found that the stools of animals fed upon carrots were sometimes nearly sterile. Salads prepared from uncooked materials, edible raw fruits and vegetables of all sorts are valuable as antitoxic foods.

6. Milk sugar, because of its slow absorption, affords an excellent means of getting carbohydrate into the colon where it is needed to suppress putrefactions. Milk sugar has the additional advantage that it encourages the lactic acid fermentation. On this account a few ounces of lactose or milk sugar is always a valuable addition to the antitoxic bill of fare. The best effect is obtained by taking the sugar before eating. It should be mixed with a little water and swallowed quickly.

7. Dextrin seems to possess the same power to encourage the growth of the *B. acidophilus* in the colon shown by milk sugar and is better suited to many cases.

8. Raw, or imperfectly cooked starch is digested more slowly than well cooked starch, and hence has a better chance to reach the colon and encourage the growth of a non-putrefactive flora. This may be provided by the use of fresh fruit and such fresh green vegetables as lettuce, cucumbers, radishes and salads of various sorts, and especially by the use of scalded oatmeal; that

is, steel-cut oats cooked six to ten minutes like the brose of the Scotch Highlands.

9. Fats, especially animal fats, must be used in moderation as an excess of fats encourages intestinal putrefaction.

10. In order to secure promptly the maximum amount of benefit from the antitoxic diet it is important to initiate the effort with a few days' special regimen to change the intestinal flora. The fruit regimen is best for this purpose (See page 532). After the flora has been changed, then the antitoxic diet should be followed systematically for an indefinite length of time.

Says Tibbles, an eminent English authority on dietetics, "A course of lacto-vegetarian dietary is exceedingly useful in the state of high arterial tension which precedes arteriosclerosis, in some forms of renal disease,—e. g., Bright's disease—in Grave's disease, gout, gravel, chronic rheumatism, liver trouble, constipation, intestinal fermentations, autointoxication, skin diseases—e. g., chronic urticaria and psoriasis—in neurasthenia, neuralgia, sciatica, cardiac and gastric neuroses, etc. A pure vegetarian diet is good for some of the patients; for others a lacto-vegetarian diet is better."

Torrey found that a diet of bread and milk produces a good or acid-dominant flora.

It was long shown by Bachman (*Zeitschrif for Klin. Med.*, 1902), that, while intestinal putrefaction is increased by fat and albumin, it is decidedly decreased by a farinaceous diet as well as by milk.

The diet should be made very simple and laxative. Fresh green vegetables and fruits should constitute a large bulk of the diet. Protein should never constitute more than ten per cent of the day's ration. Cottage cheese, buttermilk or egg yolk may be used once a day in most cases. Greens should be used daily. Milk encourages "biliousness" in some cases, causing coated tongue, bad taste in the mouth, and constipation. Very often buttermilk (*acidophilus*) may be used in such cases. When buttermilk disagrees, Malted Nuts may be substituted for milk with great advantage.

THE LOW PROTEIN DIET

(Page 849)

The value of the low protein regimen is no longer questioned. Since the epoch-making experiments of Chittenden, supplemented by those of Folin of Harvard, Hindhede of Copenhagen and other investigators, the sufficiency of a low protein diet to support life and health can no longer be questioned. Folin, in fact, states that ordinary foodstuffs contain a sufficient amount of protein to supply the needs of the body, so that a person taking a variety of fruits, grains and vegetables in his daily bill-of-fare need have no apprehension of injury because of the restriction of the amount of protein eaten, although flesh foods and even eggs may be excluded. Combe and many others have shown by many observations that by eliminating from the diet foods rich in protein, putrefaction may be controlled. When milk as well as meat and eggs is excluded, nuts must be eaten. (p. 346).

This fact has also been very clearly established by the experience of the writer and his colleagues in the Battle Creek Sanitarium, where for more than forty years a low protein dietary has been employed as a prominent feature in the general therapeutic program employed in the treatment of more than one hundred and thirty thousand patients. The great benefit derived from the reduction of the amount of protein has in most cases been so pronounced that the patient, as well as the physician, has been thoroughly convinced of the value of this regimen.

It is not necessary at this place to enter more fully into the discussion of the low protein ration, this subject having been considered at length elsewhere in this work. This diet is indicated for all persons suffering from intestinal toxemia which includes nearly all chronic invalids, and is especially indicated in cases of acute or chronic Bright's disease, arteriosclerosis, myocarditis, and mental and nervous disorders. In detail, the "low protein" diet is much the same as the "antitoxic diet." The same foods may be eaten, care being taken to keep the protein intake at a low level, not exceeding one calory per pound of body weight. Green vegetables, greens, and fruits should make up the bulk of the dietary. In most cases eggs, as well as meats, should be discarded, and milk should be used in moderation, not to exceed a pint a day. Even milk may be eliminated with advantage in many cases, four to six ounces of nuts or Malted Nuts being substituted for a time at least.

PROTEIN-FREE DIET

(Page 850)

A protein-free diet is of special service as a means of changing the intestinal flora, and in certain cases of nephritis in which uric acid and other nitrogenous wastes are retained in the blood and tissue fluids. It affords the most efficient means of eliminating from the body surplus and toxic nitrogenous compounds and combating uremia and acidosis.

The amount of nitrogen excreted daily during a period of starvation is about seven grams, representing thirty times as much muscle tissue, or seven ounces. The loss of muscular tissue does not begin, however, until about the fourth day when the "floating nitrogen," chiefly waste matters, has been eliminated. During this four days the intake of protein may be reduced to nothing without doing any damage to the vital machinery. This fact opens the way for a vital housecleaning which may be repeated at intervals as frequent as may be necessary, provided the period of complete abstinence from protein is not at any time prolonged beyond four or five days.

Meat and meat products, eggs, milk and other dairy products, are all excluded from this dietary, together with nuts, legumes and all cereals, with the exception of rice.

In the strictest form, the protein-free dietary will consist exclusively of juicy fruits, fruit juices and sugar water (malt sugar or milk sugar). Honey water may be used in moderation. The juices of sweet fruits, such as raisins and especially orange juice and the freshly expressed juice of sweet apples, are most valuable. All fruit juices are suitable, also dates.

The nutritive value of fruit juices varies from about 10 to 20 calories per ounce. Sweet grape juice, as found in the market, has a somewhat higher calory value, about 24 calories to the ounce. The most highly nutritive fruit juices have a calory value equal to that of full milk, while the more dilute juices equal skimmed milk and buttermilk in value.

At 20 calories to the ounce, a pint of fruit juice supplies 320 calories, and hence four or five pints daily, supplying 1,300 to 1,600 calories, would suffice for a person of average size while confined to the bed. This amount of liquid can be easily taken in divided doses.

A good plan is to administer half a glassful (four ounces) of juice every half or three-quarters of an hour. Fruit juice should be substituted for other fluids. In case the full amount of fluid indicated is more than the patient can easily take, its nutritive value may be increased by the addition of malt sugar or milk sugar. Two ounces of malt sugar, added to a pint of apple juice will supply approximately 400 calories. Three to three and one-half pints of the mixture will furnish a fair day's ration.

It is well to supply the patient with as large a variety of fruit juices as possible. A good substitute for fruit juice, which is better liked by some patients, may be prepared by adding to a pint of water four ounces of malt sugar or milk sugar and the juice of one lemon. Purées of ripe fruits may be used instead of fruit juices, or even the ripe fruits themselves. Watermelon, canteloupe, peaches, apricots, strawberries, huckleberries, raspberries and other small fruits, may be served with malt sugar. Rice flakes, boiled rice, rice jelly and other preparations of rice, may be used in most cases and help to relieve the monotony of this regimen when necessary so to do.

Other foods which may be used are the following: Agar jellies, green vegetables of all kinds, particularly tomatoes, cucumbers, turnips, cauliflower, cabbage, celery, squash, artichokes, lettuce, and greens. When anemia is pronounced, purées of spinach and other greens should be freely used twice a day.

Within four or five days any surplus or "floating" nitrogen which has existed in the tissues will be removed and hence it will not be necessary to continue this dietary for more than five days. The regimen may be repeated at intervals as required.

The protein-free regimen may be used advantageously in the following conditions,—in acute nephritis, temporarily in chronic Bright's disease with low renal efficiency, very pronounced cases of autointoxication, in fever accompanied by a very high temperature, in which there is reason to apprehend kidney involvement, etc.; in all cases in which the blood nitrogen is high, that is, above 40; in acute severe eruptive fevers and in eczema.

One or two ounces of agar or an ounce of sterilized bran and three to six ounces of paraffin oil should be used daily to promote intestinal activity. In addition, an enema should be used twice a day to insure thorough evacuation of the colon. These measures are highly important, and should always be employed when the patient is placed upon a liquid diet or other regimen which does not supply the necessary bulk to secure sufficient bowel action.

FEVER DIET

(Page 851)

Hippocrates fed his fever patients ptisan or barley gruel. Niemeyer was an enthusiastic advocate of fruit soups in fever cases. We are just beginning to learn how to feed fever patients, after having for years first starved and then stuffed them with milk and whiskey. When the writer was walking the wards of Bellevue Hospital more than forty years ago, whiskey and milk constituted the universal diet in typhoid, and this practice still continues in certain regions, although whiskey was long ago discredited, and milk affords the best possible medium for the culture of the typhoid germ and has been shown to be responsible for the tympanites, putrid stools, and even perforations which were common occurrences in typhoid cases under the old regime.

A better understanding of the metabolism of the body and of the significance of fever has led to radical changes in the dietetic management of fevers of all sorts, especially typhoid and other fevers of severe type. It is now known that under the influence of a high temperature vital combustions are incomplete. This is especially true of fats and nitrogenous substances. A natural consequence of this is the production of acidosis, which is responsible for the so-called typhoid state. Starvation only increases the tendency to acidosis, while abundant carbohydrate feeding has the opposite effect. Carbohydrates afford, in fact, the only efficient means of combating acidosis. Another very pronounced advantage in the use of carbohydrates is the fact that by their free use the character of the intestinal flora may be profoundly influenced, putrefactions may be largely suppressed, and thus the absorption of toxins from the colon may be proportionately lessened.

It is evident, then, that the dietary in fever patients should consist chiefly of carbohydrates. The imperfect oxidation of fats precludes the free use of this class of foods, but carbohydrates, being well utilized, may be freely employed.

The old adage, "Stuff a cold and starve a fever" has long been discredited, and yet there are still many who do not recognize the fact that there is no essential difference between a cold and a fever. As a matter of fact, a cold is a fever, a mild infection. A generation ago fever patients often became very greatly reduced by the starvation regimens to which they were subjected.

A bill-of-fare consisting chiefly of meat extracts, broths, thin gruels, etc., is a starvation regimen. On such a dietary the patient is not only starved but poisoned by the large quantities of meat extractives taken, which not only afford no nourishment but greatly tax the already overworked liver and kidneys.

Dr. Austin Flint many years ago called attention to the fact that the chemical analysis of beef tea very closely tallies with that of urine. Meat preparations of all sorts should be suppressed in fevers. Since fever is generally due to toxins developed in the body by infectious organisms it is manifestly unwise to increase the burden by the addition of toxic foods. Consequently, an antitoxic diet is especially indicated in fever, no matter what the particular infection or condition to which it may be due. A low protein diet is certainly indicated for the evident reason that a high protein diet encourages putrefactive changes in the colon and resulting toxemia. The amount of protein should certainly not be greater than that required for repair of the tissues, which is probably about one calory per pound of body weight.

Rubner, Lusk and others have shown, also, that proteins stimulate metabolism and otherwise excite the body cells to abnormal activity. This effect is certainly not needed in fever, hence particular pains should be taken to keep the protein content of the food low. Eggs as well as meat may well be discarded, though occasionally an egg yolk may be permitted. Milk must also be used in moderation. Buttermilk may be used more freely and whey may be employed liberally.

In fever there is increased production of heat; the combustion of the vital processes in the body are accelerated. If fuel is not supplied from outside sources, the body itself will be consumed. This is the cause of the great emaciation occurring in prolonged fevers. Carbohydrates are evidently needed to furnish fuel to supply the loss occasioned by the fever process and to prevent the destruction of the tissues. When food is supplied in proper amount the great emaciation seen in badly managed cases does not occur. Carbohydrates should be supplied in liberal quantities in all febrile cases. The best forms of carbohydrates are gruels sweetened with malt sugar, fruit juices to which malt sugar or milk sugar has been added, purées of fruits and vegetables and fruit soups.

The loss of lime and iron is greatly exaggerated during febrile conditions, and there is a special need for vitamins to aid in repairing the damage done to the tissues.

Great care should be taken to see that these important elements are supplied in abundance, as they are necessary to aid Nature in the healing process. The importance of this cannot be overestimated. An examination of the "fever diet" and the so-called "liquid diet" in ordinary use in hospitals, and prescribed in text-books on dietetics, will show that both lime and iron are often almost wholly lacking. When milk is used, lime is supplied in sufficient quantity, but iron is almost universally lacking, and the patient becomes anemic not only as the result of the disease from which he is suffering but because of the iron and vitamin starvation to which he is subjected by a deficient dietary.

Purées of spinach and other greens are of special value because of the large amount of lime and iron which they contain. By the free use of greens the pronounced anemia and the heart weakness which results from the depreciation of the blood and from the deficiency of food lime is prevented. Not infrequently, fever patients are fed continuously on water gruel or some other monotonous diet which is lacking not only in lime and iron but also in vitamins, so that to the damage done by the fever is added the injury resulting from a dietary lacking in these three great food essentials. Fever patients often present symptoms of incipient scurvy or beriberi which are without doubt due to unscientific feeding.

Bran or agar in various combinations should be freely used in all cases of fever except in cases of marked gastrointestinal disease. This is necessary to combat the constipation to which there is usually a decided tendency in febrile conditions. Bran may be mixed with oatmeal, rice and other cereals in liberal proportions. The average fever patient needs two-thirds of an ounce of bran or agar daily. Even in typhoid fever, agar and mineral oil may be used when the bowels do not move freely. There is no evidence that cooked bran is irritating or otherwise harmful in typhoid cases.

Malt sugar and Malted Nuts, also purées of dates, are very useful in typhoid because of their richness in food iron and lime. (See pages 170, 179, 182, 183 for foods rich in lime and iron).

In general the antitoxic dietary should be followed in fevers. The following is a list of foodstuffs that have been found especially valuable in the feeding of fever patients:—

Gruels, especially oatmeal, barley and rice gruel

Purées of vegetables
Purées of fruits
Fruit juices
Whey
Malt sugar
Meltose (Malt Honey)
Purée of potato
Purée of banana
Milk sugar
Agar jellies
Fruit ices
Malted Nuts

The amount of food given the fever patient should be equal at least to that required by an individual of the same size and weight when leading a moderately active life. It is especially important to insure a large intake of water in these cases. Water is the best means of washing the tissues free from the fever toxins and securing their elimination through the kidneys. The amount of water taken daily should be three to six quarts, a glassful of water being given the patient every half hour when he is awake. The water may be flavored with fruit juice, lemon juice or any other fruit juice, or malt sugar or milk sugar. Water should be administered by enema when a sufficient amount is not taken by mouth.

Tibbles gives the following list of diseases in which a fever diet is indicated:

Abscess of various parts
Anthrax, or splenic fever
Appendicitis
Boils, furunculosis
Breast, inflammation of
Bronchitis, acute
Bronchial catarrh
Broncho-pneumonia
Burns and scalds, extensive
Bursitis, acute
Cancrum oris
Carbuncle
Catarrh, acute
Cellulitis
Cerebro-spinal fever
Chicken-pox
Cystitis
Delirium tremens
Diphtheria
Eczema, acute
Empyema
Endocarditis
Epididymitis
Erysipelas
Erythema, acute
Fevers
Gangrene
Gastritis, acute
Glossitis, acute
Hepatic abscess
Hepatic congestion, acute
Herpes zoster
Inflammations
Influenza
Intermittent fever
Laryngitis, acute
Lichen, acute
Lymphangitis

Malarial fever
Mastoiditis
Measles
Meningitis, acute
Meningitis, tubercular
Meningitis, cerebro-spinal
Metritis, acute
Mumps
Nephritis
Oophoritis, acute
Operations
Orchitis, acute
Osteo-myelitis
Otitis media
Pancreatitis, acute
Pemphigus, acute
Pericarditis
Peritonitis, acute
Perityphilitis
Pharyngitis
Phlebitis
Plague
Pleurisy
Pneumonia
Poliomyelitis
Prostatitis, acute
Psoriasis, acute
Puerperal fever
Pyaemia
Pyelitis
Pyonephrosis
Relapsing fever
Rheumatism, acute
Rotheln; rubella
Salpingitis
Scarlet fever
Septicaemia
Stomatitis
Surgical fever
Synovitis, acute
Tetanus
Thrombosis
Tonsilitis
Typhoid fever
Typhus fever
Urticaria, acute

In all these maladies meats of all sorts should be discarded together with beef tea, bouillon and meat extracts of all kinds. Fruit juices should be freely used. Fruit soups, fruit and vegetable purées, especially potato soup or purée, cereals of all sorts in the form of mushes and gruels and purées of greens are the proper foods. The use of malt sugar and dates in place of cane sugar because of their richness in iron is important in febrile and many other acute conditions.

In mild fever cases, after convalescence begins in typhoid, and in most cases in which the fever accompanies some localized infection or inflammation, the antitoxic diet may be followed. In all cases attention must be given to the stools. Milk sugar, Acidophilus-Lactose or lacto-dextrine should be used in sufficient quantity to change the flora. The amount required is usually two or three ounces three times a day. To prevent nausea the sugar should be well diluted. Twelve to sixteen ounces of water

A bill-of-fare consisting chiefly of meat extracts, broths, thin gruels, etc., is a starvation regimen. On such a dietary the patient is not only starved but poisoned by the large quantities of meat extractives taken, which not only afford no nourishment but greatly tax the already overworked liver and kidneys.

Dr. Austin Flint many years ago called attention to the fact that the chemical analysis of beef tea very closely tallies with that of urine. Meat preparations of all sorts should be suppressed in fevers. Since fever is generally due to toxins developed in the body by infectious organisms it is manifestly unwise to increase the burden by the addition of toxic foods. Consequently, an antitoxic diet is especially indicated in fever, no matter what the particular infection or condition to which it may be due. A low protein diet is certainly indicated for the evident reason that a high protein diet encourages putrefactive changes in the colon and resulting toxemia. The amount of protein should certainly not be greater than that required for repair of the tissues, which is probably about one calory per pound of body weight.

Rubner, Lusk and others have shown, also, that proteins stimulate metabolism and otherwise excite the body cells to abnormal activity. This effect is certainly not needed in fever, hence particular pains should be taken to keep the protein content of the food low. Eggs as well as meat may well be discarded, though occasionally an egg yolk may be permitted. Milk must also be used in moderation. Buttermilk may be used more freely and whey may be employed liberally.

In fever there is increased production of heat; the combustion of the vital processes in the body are accelerated. If fuel is not supplied from outside sources, the body itself will be consumed. This is the cause of the great emaciation occurring in prolonged fevers. Carbohydrates are evidently needed to furnish fuel to supply the loss occasioned by the fever process and to prevent the destruction of the tissues. When food is supplied in proper amount the great emaciation seen in badly managed cases does not occur. Carbohydrates should be supplied in liberal quantities in all febrile cases. The best forms of carbohydrates are gruels sweetened with malt sugar, fruit juices to which malt sugar or milk sugar has been added, purées of fruits and vegetables and fruit soups.

The loss of lime and iron is greatly exaggerated during febrile conditions, and there is a special need for vitamins to aid in repairing the damage done to the tissues.

Great care should be taken to see that these important elements are supplied in abundance, as they are necessary to aid Nature in the healing process. The importance of this cannot be overestimated. An examination of the "fever diet" and the so-called "liquid diet" in ordinary use in hospitals, and prescribed in text-books on dietetics, will show that both lime and iron are often almost wholly lacking. When milk is used, lime is supplied in sufficient quantity, but iron is almost universally lacking, and the patient becomes anemic not only as the result of the disease from which he is suffering but because of the iron and vitamin starvation to which he is subjected by a deficient dietary.

Purées of spinach and other greens are of special value because of the large amount of lime and iron which they contain. By the free use of greens the pronounced anemia and the heart weakness which results from the depreciation of the blood and from the deficiency of food lime is prevented. Not infrequently, fever patients are fed continuously on water gruel or some other monotonous diet which is lacking not only in lime and iron but also in vitamins, so that to the damage done by the fever is added the injury resulting from a dietary lacking in these three great food essentials. Fever patients often present symptoms of incipient scurvy or beriberi which are without doubt due to unscientific feeding.

Bran or agar in various combinations should be freely used in all cases of fever except in cases of marked gastrointestinal disease. This is necessary to combat the constipation to which there is usually a decided tendency in febrile conditions. Bran may be mixed with oatmeal, rice and other cereals in liberal proportions. The average fever patient needs two-thirds of an ounce of bran or agar daily. Even in typhoid fever, agar and mineral oil may be used when the bowels do not move freely. There is no evidence that cooked bran is irritating or otherwise harmful in typhoid cases.

Malt sugar and Malted Nuts, also purées of dates, are very useful in typhoid because of their richness in food iron and lime. (See pages 170, 179, 182, 183 for foods rich in lime and iron).

In general the antitoxic dietary should be followed in fevers. The following is a list of foodstuffs that have been found especially valuable in the feeding of fever patients:—

Gruels, especially oatmeal, barley and rice gruel

It is to be remembered, also, that bran is rich in lime, iron and vitamins and so has a real food value aside from its laxative properties.

When the Laxative Diet Is Indicated.

The laxative diet is indicated in almost every case of chronic disease, either alone or in combination with some other specific dietary as may be required in any individual case. It is always indicated when the bowels move less than twice a day and when fecal residue is found in the colon after the last daily movement. Normally, the colon empties itself at least three times a day. Many persons, even some physicians, take alarm at this suggestion; but a short experience of the benefits of prompt and thorough clearance of the body refuse will convince the most skeptical of the necessity for frequent and complete bowel movement.

In every case of obstinate constipation the motility test should be employed. If the delay is two days or more, an X-ray examination should be made and the possibility of mechanical hindrance should be considered.

The laxative regimen is indicated especially in colitis, a very common malady which is due to infection, the result of chronic constipation. Even in cases in which there are frequent bowel movements, the laxative regimen is needed so long as the stools are putrid. There is no danger of irritation from the use of bran and laxative foods. The frequent movements are due to the fact that the colon is never properly emptied, and to the irritation caused by putrefaction products. A clean colon is the first essential for recovery. A daily enema or even two enemas daily will be found very helpful in many cases, if not always essential, in addition to a very laxative regimen.

In chronic tuberculosis, so-called neurasthenia, insomnia, skin diseases, arteriosclerosis, Bright's disease, hyperchlorhydria, duodenal ulcer, and the whole long category of digestive, nervous and nutritional disorders, a laxative regimen is of first importance.

TISSUE-BUILDING OR FATTENING REGIMEN

(Page 853)

Fluctuations in the weight of the body are chiefly due to changes in the amount of adipose tissue. After maturity has been attained the number of body cells does not materially change although the muscle fibers may increase in volume. A muscle does not increase in size, however, as the result of feeding alone. Exercise must be combined with feeding to stimulate muscular development. The tissue-building or fattening diet, then, relates chiefly to increase of adipose tissue. It is, however, important that means should be adopted also for increasing the blood cells and the volume of blood in the body since the increase of adipose tissue results practically in a dilution of the blood which is spread out through an increased area of tissue. This fact is shown by the fall in the percentage of hemoglobin which usually accompanies an increase of weight. This decrease in hemoglobin may be prevented, however, by the adoption of a diet which will increase the hemoglobin along with the increase of weight.

Thinness of flesh may be due to any one of many causes, such as fever or other wasting disease, excess of work, loss of sleep, or high tension due to worry, anxiety, suspense, apprehension, or other cause. Whenever the energy intake through eating is less than the expenditure through internal or external work, there will necessarily be a loss of weight. An increase of weight can only be induced by reversing the balance. To accomplish this, the causes of excessive energy expenditure must be removed or reduced as much as possible. When a rapid gain of flesh is desired, it is usually best to keep the patient in bed or at least to keep him horizontal and as quiet mentally and physically as possible, by this means reducing ''tension'' as well as muscular work.

In arranging a fattening bill-of-fare, the relation of the several food principles to adipose tissue must be kept in mind. For fattening purposes it is evidently useless to increase the protein intake, at least so long as the patient is at rest, for the reason that protein cannot be stored in the body. It can be used only for repair and growth. If the growth of the muscles is not being stimulated by exercise, there is not only no demand for an extra intake of protein, but there is no way in which the body can be made to store a surplus of it beyond what is absolutely necessary for repair, which amounts to less than one calory per pound of body weight.

The case is quite different with carbohydrates and fat. These food principles, when taken into the body in larger quantity than is needed for fuel purposes, are retained and build up the adipose or residual tissue. Fats are absorbed and carried direct to the fat depositories of the body. Carbohydrates, after conversion into dextrose, the sugar of the body, are converted into fat if not needed for immediate use as fuel. Each ounce of surplus fat taken in the food becomes an ounce of fat in the body. In the case of carbohydrates, starch and sugar, however, the case is different, each ounce adding to the body weight three or four ounces instead of one. It is evident, then, that of the several food principles, carbohydrates are best adapted to increase body weight. Carbohydrates have the further advantage, also, that they are much more quickly and easily digested and assimilated than are the fats.

It is possible, also, to greatly increase the intake of carbohydrates without producing disturbance of digestion or of any other function. An increase of protein, through the use of meat, eggs, oysters, etc., increases the intestinal putrefactions and so tends to create toxemia. Fats, when freely taken, are likely to impair the appetite by delaying the movement of food through the stomach and intestines and also by increasing the putrefactive changes in the colon. A moderate increase of fat and a very considerable increase of carbohydrates is the physiologic formula for securing a rapid increase of weight. The free use of meats offers no advantage whatever and is indeed a positive disadvantage, since protein does not make fat and consumes energy in excessive heat production and by overworking the liver and kidneys in the elimination of surplus waste.

The amount to which the food intake is increased will depend upon the rate of increase in weight required or expected and the appetite and digestive powers of the patient. Not infrequently the emaciated patient will be found to be greatly underfed, the daily intake of food often being not more than two-thirds the amount required for full nutrition, sometimes even less. In such a case the amount of food habitually taken must be doubled. In general, the calory value of the daily ration must be made 25 to 50 per cent. more than the amount required for bare maintenance. By reference to the table (see page 100), the number of calories required for maintenance may be found, and this should be increased by one-fourth to one-half. If the patient is put to bed and all exercise prohibited, the base ration may be made the foundation for the feeding and should be increased 50 to 100 per cent. The maximum increase should not be made at once, but the amount of food should be increased from day to day, the maximum being reached by the end of the first week and maintained until a satisfactory increase of weight has been secured.

Whenever possible, the patient's metabolism should be tested. By this means, much time may often be saved. If the metabolism rate is much increased, this will at once explain the loss of flesh and will show the necessity for complete rest in bed as the most efficient means of reducing metabolic activity. The systematic use of clinical metabolism tests, first employed at the Battle Creek Sanitarium, is now in use in several of the progressive clinics of this country.

As a preliminary to the fattening regimen, the employment of the fruit regimen for three or four days has the advantage in most cases of greatly promoting appetite and facilitating the gain in flesh when the fattening regimen is established.

The dietary must include foods rich in lime, iron and vitamins as well as carbohydrates and fats. This is important for the reason that in many cases of emaciation the cause is in large part a lack of the essential growth-promoting vitamins which are abundant in fresh milk and greens but are found only in very small quantity in most other foodstuffs, being almost wholly lacking in meats and in cereals as commonly used. Foods rich in vitamins also serve to increase appetite for food and ability to utilize it.

In connection with the fattening diet it is important to adopt efficient measures for increasing appetite; that is, moderate cold bathing, particularly such measures as the cold mitten friction, cold towel rub, and for persons of average strength, the cold wet sheet rub or cold shower bath. Out-of-door sleeping and almost continuous life out of doors is another measure of highest value and should not be forgotten. Abundant sleep should be secured. Ten to twelve hours daily is none too much.

Among the foods of special value for fattening purposes may be mentioned malt sugar, milk sugar, Malted Nuts and fresh cream. A food par excellence is fresh cream or butter combined with Malt Syrup, Malt Honey or Meltose.

In many cases it is of very great advantage to give the patient, in addition to the three regular meals, two or three minor meals consisting of malt sugar or milk sugar dissolved in water, either with or without fruit juices of some sort. See Supplementary Feeding, (p. 550.) Carbonated water may often be used with advantage, as the gas set free in the stomach has the effect to stimulate gastric activity and hasten the emptying of the stomach. In order that the intake should be as large as possible, it is best that it should be simple in character, so that the tax upon the digestive organs may be as little as possible. Complicated dishes should be avoided and only a few different dishes served at each meal. When eggs are eaten, the white should be discarded. The yolk of an egg possesses twice the food value of the white and is much more easily digested, while supplying also a rich store of lime iron and vitamins which are deficient in egg white.

In connection with the rest cure, it is unwise to allow patients to stay in bed too long. A week or two is usually sufficient. At the end of this time systematic exercises should be begun, gradually increasing in vigor from day to day. With the increase of exercise the appetite will also increase, and when things are managed well, the patient's gain in weight will continue without interruption and may be substantially increased because of the improvement in appetite.

The fattening regimen is indicated especially for persons who have been reduced in weight by acute or chronic disease or by malnutrition resulting from any cause. Persons who are convalescent from an acute illness and consumptives are excellent subjects for the fattening regimen.

The milk regimen (p. 539) is one of the most efficient of all methods of creating a rapid gain in flesh. When it can be made acceptable to the patient, and is not contraindicated, this regimen may be adopted with advantage. There are, however, many cases in which the patient is sensitized to milk or in which for some other reason it cannot be tolerated.

Cane sugar should never be employed as a means of increasing the intake of carbohydrates because of its irritating properties. Malt sugar and the sugars of sweet fruits, and fruit juices, may be used to any extent which may be desirable without injury.

Milk sugar is sometimes useful in doses of three ounces three times a day as a means of changing the intestinal flora. Large dose of milk sugar sometimes give rise to nausea. In such cases lacto-dextrin may be used or Acidophilus-Lactose, also acidophilus buttermilk.

Malt sugar may be used in divided doses to the extent of ten or twelve ounces daily. When carbohydrates are used in large quantities for some time, it is a wise precaution to apply the Bergel test to the urine, for the purpose of detecting any elimination of imperfectly utilized carbohydrates. When possible, it is well to make, also, a determination of the blood sugar.

One of the most important indications for the carbohydrate diet is the preparation of patients for severe surgical procedures, instead of fasting the patient. In cases in which it is desirable that the intestinal tract shall be free from residues, the result desired may be secured by feeding the patient on carbohydrates, exclusively, for a few hours before the operation. Malt sugar is best adapted to this purpose. The commercial product consists of approximately equal parts of maltose and dextrin, which are quickly digested and absorbed, and produce no disturbance.

The old teaching respecting carbohydrate indigestion has literally no scientific foundation. When much flatulence appears after the free use of carbohydrates, it is not to be attributed to the carbohydrates themselves, but rather to the presence in the intestine of gas-producing micro-organisms which do not belong there, and which disappear when the dietary is managed in such a way as to produce a transformation of the intestinal flora, restoring the normal and beneficent *B. acidophilus*. This change may usually be effected in a week or ten days by feeding two to three ounces of milk sugar or Acidophilus-Lactose three times a day.

Gas in the intestine is the result of the action upon carbohydrates of Welch's bacillus, an organism which causes gas gangrene and is also the cause of putrefaction in the intestine and elsewhere. The colon bacillus is also to a less extent productive of gas. These organisms produce little gas on a flesh diet; but when they are present in large numbers in the colon, the addition of much carbohydrate to the diet will give rise to much gas. The acid forming organisms do not produce gas; hence, as soon as the flora is completely changed or nearly so, the gas disappears. So while it is true that a carbohydrate diet gives rise to gas in many cases, the remedy is to be found, not in less carbohydrate, but more.

THE RESTORATIVE REGIMEN

(Page 854)

The discovery of vitamins has in recent times brought into clear view the cause of a great number of cases of chronic malnutrition which were formerly highly obscure and were often subjected to treatment during long periods without satisfactory results. Extended researches by Bunge of Switzerland, and Sherman of this country, together with Mendel, Osborne, McCollum, and others, have also thrown much light upon these cases. It is now known that in a large proportion of instances in which individuals suffer from general feebleness, lack of vigor, endurance, efficiency, and sense of well-being, a state of semi-invalidism or valetudinarianism without evidence of any clearly defined malady, their troubles are due to malnutrition, the result of a deficiency of vitamins, lime, iron, and other salts in the food. There is no doubt that in this country alone there are many tens of thousands of persons suffering from a deficiency of these highly essential food principles in their daily food. Such persons often derive great benefit from short vacations, partly perhaps because of a change from their accustomed inadequate bill-of-fare to one which supplies some of the lacking elements. On returning home they find themselves quickly relapsing into the old conditions. When such individuals are placed upon a dietary which supplies the needed diet factors, they often make surprisingly rapid gains in weight, strength, mental and physical vigor, and in general physical well-being; the blood corpuscles increase in number, the blood becomes richer in hemoglobin, the appetite improves and a notable physical uplift is experienced.

Not infrequently, patients of this class are recommended to adopt a heavy meat diet, but the hoped for results do not appear for the excellent reason that meat is itself notably lacking in both vitamins and lime. In the animal body 99 per cent. of all the lime present is found in the bones, the flesh being almost wholly lacking in this element, and the vitamins are likewise concentrated in special structures, being found almost exclusively in the liver, spleen, kidneys, and other glands.

Caspari of Berlin, found that casein is superior to flesh as a source of protein. This was observed to be true in both the human subject and the dog.

Among restorative foods will be found those foodstuffs which are particularly rich in the elements that are needed for refurnishing the blood, bones, nerve and tissue fluids with the elements needed for complete nutrition. Greens of all sorts, milk, butter, cottage cheese and other dairy products; all grains, particularly oatmeal and millet; fruits, especially the orange, the tomato and the apple and fruit juices of all sorts; potatoes, artichokes, turnips and other roots and tubers, the onion, properly cooked; these are all highly valuable, also salads prepared from fresh, uncooked materials. (See Raw Diet, p. 610.) The lentil should not be forgotten because of its richness in lime and iron. Bran should be freely used at every meal because of its rich store of lime, iron and other salts as well as vitamins.

A vegetable purée, or consommé, prepared from a variety of vegetables may be used with great advantage for both adults and infants whose tissues are poor in mineral constituents in consequence of long feeding on a diet deficient in food minerals. The mixture may consist of string beans, shell beans, especially the Hahto bean, green peas, young beets with the tops, radishes, turnips, young turnip tops, celery, artichokes, spinach, tomatoes, mustard greens, and almost any other green or fresh vegetables. Add cold water enough to cover, bring to a boil and simmer five or ten minutes. Put into a fireless cooker over night. Pass through a colander, taking care to save all the water. Serve as a consommé, or add Japanese isinglass and allow to jelly.

Greens, fresh vegetables and fresh fruits should be taken in liberal quantities at two meals daily. Better results still will be obtained by taking greens at every meal in quantities of four to six ounces. Most surprising results in blood building may often be obtained by the very abundant use of greenstuffs.

Tomato juice, either fresh or canned, potato soup, oranges, lemons, grape fruit and tamarinds are rich in the antiscorbutic vitamin which is often needed in these cases. Wheat germs, sprouted soy beans or better Savita, an extract of yeast, are also to be highly recommended.

All edible green things, such as lettuce, celery, cucumbers, cabbage, green corn (uncooked), carrots, turnips, salads, and melons should be conspicuous in the bill-of-fare.

The daily use of a pint and a half or two pints of certified milk, a quart of yogurt buttermilk and liberal quantities of cream and butter is conducive to rapid improvement. Cottage cheese is especially valuable for the lime and vitamins which it furnishes.

Elsewhere in this volume will be found lists of foods which are rich respectively in vitamins, lime and iron (See pages 170, 179, 182, 183, 192, 193), which should receive careful study. Foods which contain an abundant supply of lime and iron are certain to contain a sufficient amount of the other mineral salts required by the body.

THE FASTING REGIMEN

In recent times numerous attempts have been made to exploit the idea of fasting as a panacea for human ills. However, there is no danger that this drastic method will ever become a popular fad. Only heroic souls and fanatics are likely to become enthusiastic devotees of a method which requires the amount of self-control and endurance incident to the withholding of food during periods of one to six weeks.

Voluntary fasting probably originated as a religious rite. It was prescribed as a penance, or was undertaken for the purpose of encouraging a state of spiritual elevation.

That a person may live without eating for a considerable period has been clearly demonstrated by the experience of Cetti and Succi, the Italian fasters, Doctor Tanner, and others. Professor Luciani, who observed the faster, Succi, during a thirty days' fast, found him a demented person (formerly insane) who believed himself to be "the son of God," and who fasted for the purpose of demonstrating the indestructibility of his divine body.

Various professional fasters as well as fasting animals have since that time been studied by physiologists in different parts of the world. The uniform testimony of these expert observers has been that the withholding of food does not exercise the prompt control over intestinal putrefactions that might be expected. Food is not the only source of putrescible material in the colon. The bile, intestinal mucus and other intestinal secretions that are constantly poured into the alimentary canal furnish a sufficient amount of putrescible material to maintain a luxuriant putrefactive flora. When these materials are promptly discharged from the body there is not, however, sufficient time for the development of the putrefactive process, which requires much more time than is needed for the development of the fermentative changes to which carbohydrates are subject. In fasting, however, there is almost complete inactivity of the intestine. Food is the natural excitant of peristaltic activity. Whenever food is taken into the stomach, active contraction waves begin at once, traversing the stomach at the rate of three to five a minute, and passing along down the whole alimentary tract. When food is withheld, these movements cease, the biliary and other excretions accumulate and undergo putrefaction; the poisons are absorbed, the tongue becomes coated, the breath foul, the urine loaded with the products of putrefaction and all the evidences of intestinal autointoxication become intensified.

In the case of the faster, Cetti, observed by Lehmann, the first stool after the beginning of the fast occurred on the ninth day. The amount of phenol, a putrefaction product, found in the urine, had increased in the meantime to nearly five times the amount present at the beginning of the fast. The condition of the urine was the same as that which is usually observed in cases of obstruction from peritonitis or other causes, the result of the paralyzed condition of the bowel due to complete abstinence from food. Examinations of the urine of Succi, the famous Italian faster, made by Apollo and Solard by Bouchard's method, showed its toxicity to be greatly increased. These facts show most conclusively that fasting is not, as claimed, an efficient means of cleansing the body from poisons.

Starvation suspends the secretion of the digestive juices. "The secretion of saliva diminished in acute starvation even when water was taken ad libitum. Thus Succi, on the seventh day of his fast, only produced as much saliva by the movements of his jaws in three hours as under ordinary circumstances is secreted in five minutes" (Van Noorden).

In fasting, the stools were highly putrid and "similar in appearance to the feces passed when the diet is mainly composed of meat" (Von Noorden).

Says the same author, "The blood atrophies."

Statkewitsch studied the effects of fasting in a large number of animals—cats, dogs, rabbits, pigeons, frogs, lizards, and other animals—and found that after prolonged fasting the cells of the heart, liver, muscles, kidneys, pancreas and other glands were *the seat of degenerative processes.* These processes were most marked in the muscles and the glands.

Zander found evidences of degeneration of the heart muscles in pigeons after fasting eight to twelve days.

Gaglio found cloudy swelling of the muscles, granular and fatty degeneration of the liver in fasting frogs.

The Fasting Body Feeds Upon Itself.

So long as life continues, the fasting animal body continues to consume energy although at a reduced rate. The energy output of the body during fasting is three-fifths to three-fourths the ordinary output. In the absence of the usual source of energy, food, the body feeds upon itself and is consumed at the rate of about one-eightieth of its weight each day. The stores of fat are first drawn upon, then the muscles, glands and other structures are consumed to keep the fires of the body burning. The heart muscles and some other organs may lose as much as one-half their weight. This process of degeneration may be carried so far that the body cannot recuperate itself. According to the London *Lancet*, the professional faster, Succi, although only thirty-eight years of age, had the appearance of a very aged person; not only his face but his entire body was covered with deep wrinkles. His muscles were so atrophied and degenerated that he looked like a skeleton and had the appearance of a person suffering from incipient marasmus.

Loss of Weight During Fasting.

A man of average size when at rest and fasting, burns up daily about 75 grams (2¾ oz.) of protein (muscle and gland tissue), 25 grams (5/6 oz.) of glycogen (animal starch stored in the liver and muscles), and 200 grams (6⅔ oz.) of fat (adipose tissue), amounting in all to ten ounces of tissue consumed. But this does not represent the total loss of weight for the reason that with each ounce of carbohydrate or protein (glycogen or muscle) consumed, three times the same weight of water is lost, so that the actual loss in weight for the muscle and glycogen burned is 100 grams × 4 = 400 grams or 13½ ounces. Adding the 6⅔ ounces of fat, the total loss in weight is 20 ounces, or double the weight of the actual solid matter consumed by the body processes.

If the patient exercises, the loss of weight will be much greater. It may be easily doubled by a moderate amount of exercise.

The following table (Von Noorden) shows the percentage of loss sustained by some of the principal organs and tissues of the body during fasting:

Fatty tissue	95 per cent.
Muscles	40-46 " "
Heart	40-45 " "
Glands	40-45 " "
Blood	40-45 " "
Bones	10-15 " "

Many persons have passed through the ordeal of a long fast and have survived, and in some instances there has been evidence of a notable improvement in health following a long fast. There are, in fact, certain advantages in fasting which may be briefly stated as follows:

1. By fasting, surplus body fat may be disposed of. During a fast the body feeds upon its reserves.

2. Any accumulation of surplus or "floating" nitrogen or wastes which may be present will rapidly disappear during a fast. It is true that the amount of surplus protein and tissue wastes which may accumulate in the body can never exceed a very small amount, certainly never more than a few pounds; but that these objectionable substances may be present cannot be denied, and by a fast they are gotten rid of.

3. Fasting creates an appetite by producing an imperious demand for food and perhaps at the same time increases the ability of the tissues to assimilate food. This effect of fasting may be an advantage in certain cases, particularly when it is desirable to produce a rapid gain in flesh by subsequent overfeeding.

4. There is some evidence that a prolonged fast may in some cases produce a sort of rejuvenescence of the tissues. It has been shown by experiments upon animals that in certain lower organisms, particularly in certain mites, a remarkable rejuvenescence results from a fast prolonged to such a degree as to reduce the creature to a fraction of its original proportions. These experiments, however, have been made only upon animals of the lowest orders, and there is so far no evidence that a similar change can be effected in human beings. However, the observation has been made that after a prolonged fast, when the body has been built up by proper feeding, there is apparently present an unusual degree of vigor and an enhanced sense of well-being. It is to be noted, however, that a similar observation is often made following recovery from typhoid fever or some other acute wast-

ing disease in which the patient has been greatly reduced. It is to be further noted, also, that notwithstanding this apparent rejuvenation accompanying convalescence from fevers, the life expectancy of such persons is only one-half that of the average person of the same age. Hence there is ground for believing that, notwithstanding the apparent improvement resulting from the fast as well as from the fever, a certain constitutional damage is done, the effects of which become apparent later. It is certainly irrational to suppose that great benefit can come from prolonged and painful resistance of a natural instinct with which the body is endowed by Nature for its protection by securing the prompt and regular meeting of its essential requirements. Hunger is a sensation through which Nature serves notice upon the consciousness that the energy resources of the body are running low and need to be re-enforced; in other words, that food is needed. Thirst is a sensation which notifies the intelligence of the need of water. On purely *a priori* grounds it would seem to be highly unreasonable that man should use his intelligence to thwart this means of automatic defense of the body against injury.

Arguments could be offered in favor of water fasting as well as of food fasting. Indeed, why should not one restrain himself from gratifying the sense of air hunger which prompts constant rhythmic action of the lungs? Air hunger, water hunger, and ordinary hunger are simply Nature's demands for supplies of different kinds of foods which the body needs for its protection and the maintenance of its functions.

When food fasts were practiced by the empiric Priessnitz at Gräfenburg in Germany more than a century ago, a neighbor set up on the opposite side of the mountain a rival establishment at which water fasting was the method employed, and Dr. Schrott, the founder of this absurd method, claimed as wonderful cures as those which have been exploited by the fasting faddists of recent years. Furthermore, notwithstanding the apparent advantages which have been mentioned above as possible results from fasting, it is evident that there must be certain disadvantages; and when these have been considered, it will be found that the disadvantages of prolonged fasting very far outweigh any advantages which may be derived therefrom. And not only this, it will also be found that all the advantages derived from complete abstinence from food, the "absolute diet" of the French, may be more easily and more comfortably obtained by a scientific regulation of the diet and without any of the dangers and disadvantages which attach to the fasting method.

Objections to Fasting.

Here are some of the serious disadvantages which are properly attributable to fasting, and the force of which cannot be denied.

1. Fasting produces a harmful destruction of the "noble" tissues of the body; that is, while a prolonged fast rids the body of surplus fat and of accumulated wastes, it at the same time involves a notable wasting of the muscles, including the heart, and shrinking of the liver, kidneys and other tissues, a marked reduction of the blood volume and destruction of the blood corpuscles and a great loss of the essential salts, lime, iron, and other materials of which the bones, brain, and blood are robbed.

2. The body contains, almost wholly in the blood, about forty-five grains of iron. More than a fifth of a grain of iron is lost daily. The life of the blood cells is about six weeks. When the cell dies it gives up its iron, which is eliminated in the bile by the liver and becomes a waste product. Experiments upon animals have shown that the body loses forty per cent of its store of iron within three weeks when the daily intake of iron is wholly suspended. In a fast of four or five weeks the body would lose more than half of its blood iron, and must necessarily likewise lose a proportionate amount of its oxygen-carrying capacity. In like manner the body, when fasting, daily loses a certain amount of lime, which in the course of several weeks amounts to a sufficient quantity to rob the bones and the blood of an element essential to their integrity.

3. The body is also continually losing vitamins which are essential for the promotion of the processes of repair and the maintenance of the various vital functions. The daily supply of vitamins is as necessary as the daily supply of air and water. Vitamins cannot be produced by the animal body. They are an exclusive product of plant life. The liver hoards a small store of vitamins sufficient to serve in emergency, but the supply is not sufficient to last indefinitely, and as shown by the experience of sailors who contract scurvy and those who become the victims of beriberi through living upon polished rice, the vitamin store of the liver soon becomes exhausted and the body then falls into

serious disorder. Fasting deprives the body of vitamins and thus involves the risk of serious injury for which no adequate compensation is offered. The total loss of all vitamins must certainly involve greater damage than the loss of one only, yet the absence of but one of the three known vitamins for even a short period produces noticeable injury. Certainly the body can be in no way benefited by the deprivation of food iron, food lime, and other food salts, and of the precious vitamins, the activators of the vital processes.

4. A fasting person is starved only in conventional sense. As a matter of fact, his body feeds as usual, but instead of obtaining his food supply from outside sources, it feeds in part upon reserve fat which has been laid up in store for the purpose, and in part upon the living machinery of the body, muscles, nerves, brain, glands, etc., as already noted. In other words, a fasting person feeds upon himself, upon animal flesh, a strictly carnivorous diet. He is not only a flesh eater but a cannibal and even worse, he is autophagic. The effect of a strictly flesh diet is always unwholesome. Even the dog suffers physical impairment when fed exclusively upon flesh. So must the flesh feeding faster.

5. Examination of the blood of a fasting person shows that there are present poisonous acids, particularly beta-oxybutyric acid and diacetic acid, two highly poisonous substances which seriously impair the power of the blood to carry CO_2. The cause of these poisons is the imperfect oxidation of the body fats which is always the result of a deficiency of carbohydrates. It has been shown by Naunyn and others that the body requires daily 200 or 300 calories of starch or sugar (2 or 3 ozs.) to enable it to burn up the fats of the ordinary diet, and when the body is compelled to subsist largely upon its own fats, acidosis quickly develops. It thus appears that long fasting, instead of clearing the body of poisons, produces new and dangerous poisons which grow out of the fact that the fasting body is compelled to feed upon itself. The free use of fruit juices and a moderate use of unsalted mashed potatoes, greens, juicy fruits, with perhaps the addition of a few ounces of malt sugar or milk sugar, will prevent the evil effects of fasting, while at the same time securing all the results desired from underfeeding.

6. It is true, as above admitted, that during a prolonged fast any surplus of protein which may be present in the body may

be used up and accumulated tissue wastes may be lessened in amount. But the amount of such accumulations is too small to justify the expensive method adopted by the faster for their elimination. For example, Gautier has shown that the total tissue wastes or soluble salts of the tissues amount to only about ten per cent. of the total solids. In a man weighing 150 pounds, the soft parts and viscera have a weight of about 125 pounds. Three-fourths of this is water, giving less than 32 pounds as the total solids of the soft parts. Of this, 10 per cent., or 3.2 pounds, represents the maximum of excretory products and stored protein which fasting is supposed to be able to eliminate. In a prolonged fast, losses of weight of 25 to 30 or even 40 or more pounds frequently occur. It is at once apparent that the faster, in order to free himself of three pounds of waste or undesirable material, sacrifices an amount of healthy and useful tissue ten times as great. Why should one throw away 30 pounds of good muscle, brain, nerve, heart, blood, and other useful, vital machinery in order to get rid of three pounds of waste material which can be easily gotten rid of by simply restricting the diet and increasing the intake of water?

The surplus protein and tissue wastes are derived exclusively from the protein of the food. Fats and carbohydrates leave no poisonous residues behind but are converted into harmless water and carbon dioxide which quickly escapes from the lungs.

It is evident, then, that all that is necessary to secure all that can be accomplished by a long fast in freeing the body from tissue poisons may also be secured by the adoption of a protein-free dietary which will compel the body to use up its surplus protein and give it an opportunity to eliminate any surplus tissue poisons, while at the same time keeping the body supplied with fuel to furnish animal heat and muscular energy and thus preventing the necessity for the tearing down of its vital machinery and the loss of blood, vitamins and other essential elements.

Fasting is certainly the most wasteful and ineffectual method of body purification that could possibly be conceived. The daily drinking of two or three extra quarts of water, with proper exercise, and even a reasonable limitation of the intake of protein and fats will accomplish even more than the fast and without incurring any of its risks.

7. But the eminent absurdity of the fast as a method of depuration becomes apparent when some of the conditions present

in fasting are considered. Food is the natural laxative. Under the influence of food the stomach and the entire alimentary canal are stimulated to rhythmic activity through which the food is mixed with the digestive juices, spread out over the mouths of the absorbents, and when reduced to a small remnant of indigestible and unusable residues, is dumped into the colon and finally dismissed from the body. When food is not taken, these rhythmic movements disappear, and no indigestible and non-absorbable material is passed along into the colon. Consequently, the colon remains inactive. The faster argues: "I am eating nothing, hence there is nothing for my bowels to remove and no occasion for bowel movements." The argument seems conclusive but it is not. The colon has another function than that of removing food residues. A highly important and essential part of its function is the removal of the body wastes which are excreted by the liver in the bile and also extracted from the blood by the intestine itself; in other words, the colon is an excretory organ as well as a garbage disposal plant. This excretory function has been quite overlooked by the exploiters of the fasting method. They have thought only of the food residues.

I was once consulted by a faster who asked me to look at his tongue. It was very thickly coated and his breath was highly offensive. He stated that he had been fasting for three weeks and had hoped constantly that his tongue would clear, but instead it had steadily become worse. I said to him, "You are highly toxic; I think you should have a movement of the bowels."

"But," said he, "there is nothing in my bowels to move. I have eaten nothing in more than three weeks and took care to thoroughly move my bowels by enema the day I began my fast. Of course there is no occasion for bowel movement."

I urged him to secure a thorough bowel movement, which he did by taking a dose of salts. A day or two later he reported to me that the result of his purgation was a surprising amount (several quarts), of the most offensive material that he had ever come in contact with.

Every person who takes a prolonged fast becomes highly toxic. The bile, mucus, and other secretions are constantly pouring into the intestine, which, lying quiet because there is no intake of food, permits an accumulation of these poisonous and highly putrescent materials. The liver produces daily from 16 to 20 ounces of bile. The watery portion of the bile is re-absorbed, leaving the solids behind to undergo putrefaction, along with mucus and other secretions of the various glands which line the intestines. The constant swallowing of saliva supplies the bacteria necessary to transform this accumulated refuse into a seething mass of horrible corruption such as is practically impossible except during a complete fast, for the reason that the digestive process calls forth the disinfecting gastric juice by which the intestine is protected from the action of bacteria, at least to a large degree,—a protection which is lost during fasting. It is evident, then, that in his attempt to free himself from poisons the fasting man actually increases the number and virulence of the poisons which his body must combat, and it is no wonder that now and then a faster succumbs to the terrible toxemia produced by the conditions created by the fast.

The late Horace Fletcher was at one time a believer in the fasting theory and himself tried the experiment of fasting. At the end of two weeks he found himself so highly toxic, his tongue so badly coated, and his breath so horribly fetid that he did not dare pursue the experiment further and though he had no appetite he broke his fast by a small taste of baked beans of which he was usually very fond. Though he had no desire for food before placing the beans in his mouth, the moment his palate recognized the familiar taste, a very robust appetite developed and he found difficulty in restraining himself from eating more than was prudent.

This experiment cured Mr. Fletcher of his interest in fasting. But a more enthusiastic devotee might possibly have been satisfied with the explanation that if the fast had been continued two or three weeks longer his tongue would have cleared and the toxemia disappeared. That such a change sometimes occurs, seems to be well attested by a number of fairly reliable witnesses. The explanation is to be sought in the same direction as that of a similar phenomena which occurs in connection with typhoid fever. After being heavily coated for several weeks the tongue suddenly begins to clear off and convalescence sets in with a return of appetite and improvement in other symptoms. This change in the typhoid patient is the result of the establishment of immunity due to a defensive effort of the tissues, which alone makes recovery from an infectious disease possible. In prolonged fasting there is often observed a toxemia as intense as that which occurs in typhoid fever. It appears to the writer that in cases in which the tongue clears spontaneously after prolonged fasting the change is due to a temporary immunity developed through the absorption of the endo-toxins derived from the enormous quantities of bacteria which perish during the long retention of fecal matters in the colon.

From the foregoing considerations it must be apparent to the candid reader that prolonged fasting is by no means a harmless procedure, and that it is indeed a method fraught with danger and liable to produce irreparable injury. The writer recalls several persons in whom through long fasting, the heart muscle was so weakened from the wasting to which it was subjected that many months were required for even partial restoration. All these dangers may be avoided by scientific fasting, which consists, in a word, of the elimination from the diet of the harmful elements, fat and protein, while not depriving the body of the precious resources of energy with which it must be constantly supplied in order that its functions may be maintained.

Safe and Scientific Fasting.

There are several methods of fasting by means of which one may secure all the advantages of the prolonged fast without any of the dangers and inconveniences which long fasting involves. A one day fast now and then is found by many individuals highly beneficial in recovering lost appetite, relieving headache, dullness, depression, and various other unpleasant symptoms. The fasting should be accompanied by copious water drinking. Four to six quarts is none too much. A good plan is to take a glassful of water every hour. A little fruit juice may be added to the water to give it flavor. An ounce of agar or bran should be taken during the day and two to four ounces of paraffin oil. It is also well to take, morning and night, an enema consisting of two or three pints of water at 80 to 90 degrees.

A second method of fasting which will yield excellent results is to live for a week on greens and fruit. Fresh or canned tomatoes should be used liberally with fruit juices of all sorts and melons. Twice a day a liberal serving of greens, four to eight ounces, should be eaten with large servings of lettuce and celery. One to two ounces of bran should be taken during the day or an ounce of agar. A couple of ounces of paraffin oil should be taken morning and night.

A most satisfactory method of fasting is the protein-free diet or protein fast (p. 573).

REDUCING DIET

(Page 855)

In most cases of obesity and in certain cases of high blood-pressure a reduction of body weight is a matter of primary importance. In obesity especially the only radical means of relief is to be found in a diminished intake of food. If food is withdrawn altogether, the body is compelled to draw upon its food reserves in the form of adipose tissue, and the weight will in consequence be diminished at the rate of one to two pounds a day, or about one-eightieth of the body weight. If this reduction of weight were confined to the loss of fat, fasting would be a most practical and efficient method of weight reduction. But careful laboratory observations have shown that in complete fasting all the tissues of the body are drawn upon to furnish energy with which to keep the wheels of life moving. The muscles, including the heart and the glandular structures, lose weight as well as the adipose tissue. Consequently, the muscles waste and lose strength, the heart is weakened and all the bodily machinery is crippled and rendered less efficient. On this account, absolute fasting is seldom advisable, but a modified fast may render very great service. See Fasting (p. 590).

A good plan is to put the patient on a regimen which will furnish him with the calory requirement of his base ration, which is approximately three-fourths the amount of food required by a person of a given height doing light work. The base ration for a person of any height may be found by reference to the table given on page 100.

When a decided reduction in weight is necessary, the food intake should be reduced to one-half the ordinary ration or about three-fourths the base ration for a short time.

This reduced dietary should not be continued indefinitely. As the reduction in weight proceeds, the intake of food should be gradually increased until nearly the normal amount is eaten, care being taken to avoid the slightest excess.

Having determined the amount of food to be given, the next thing is to determine the particular foodstuffs best calculated to facilitate a reduction in flesh, bearing in mind always, however, that it is the amount of food, that is, the number of calories eaten rather than the particular kind of food, which is of primary importance.

An important point to be borne in mind in the employment of the reducing dietary is the fact that when the volume of the food intake is diminished, there is a tendency to constipation because of a lack of the bulk required to stimulate the muscular walls of the intestine. On this account, care should be taken to avoid reducing the volume of the food; in fact it is highly advantageous to increase the food volume by the use of liberal quantities of celery, lettuce, cucumbers, greens and bran, together with other bulky foodstuffs.

Salt should be used sparingly. A moderate amount of liquids (8-12 ounces) may be taken at meals. The variety should be small at one meal, but varied from day to day. The appetite must be restrained even if necessary to rise from the table a little hungry. A pint of water taken one-half hour before meals and again at night and on rising in the morning is beneficial and helps to quiet hunger pangs. The amount of protein should not exceed one calory per pound of body weight.

In arranging the bill of fare for reducing weight, bulky foods should be served first for the reason that fullness of the stomach produces satiety and so satisfies the appetite even though the calory or real food value of the meal may be small. Liberal quantities of celery, lettuce, fresh fruits, cucumbers, melons, and greens may be eaten at each meal without aggregating more than a few hundred calories. At least one-fourth ounce of bran, or a third of an ounce of agar should be taken at every meal. Bran supplies lime, iron and vitamins, the amount of which in the daily ration should not be reduced. This is a point which has heretofore been neglected in all diets which have been proposed for reducing flesh, a serious oversight which has unquestionably been a most prolific cause of failure and has often resulted in producing a state of ill health as the result of attempts to reduce weight, recovery from which has frequently required many months. It is a frequent observation on the part of persons adopting any of the usual methods for reducing body weight that while they feel lighter from the loss of flesh, they recognize at the same time a notable loss of energy, endurance and sense of well-being. This experience is often so pronounced as to lead the individual to prefer efficient obesity with its inconveniences to a state of more comely, but inefficient leanness. This may be easily prevented.

The best method of maintaining the full required intake of iron, lime and vitamins is by the free use of vegetable broths, greens, yeast extract (Savita, Marmite), oranges, tomatoes, either fresh or canned, and such green vegetables as cucumbers, lettuce, cabbage, (kraut), and celery.

At the very beginning of a course of diet to reduce weight, food may be almost wholly withdrawn for the first three or four days. Care should be taken, however, not to reduce the intake of carbohydrates below 300 calories, the equivalent of 5 ounces of bread, 12 ounces of grape juice or a pint and a half of apple juice. On such a regimen the weight may be readily reduced by diet alone from a pound to a pound and a half a day for three or four days in succession. Adding vigorous exercise, the rate of reduction may be materially increased; for example, a 300 pound man walking for one hour a day at the rate of three miles an hour would in so doing utilize energy equivalent to one million foot pounds, or about 330 calories, which would be represented by an ounce and a half of fat. Walking two hours would double the effect, which would be shown in a reduction of weight to the extent of probably half a pound or more. By thus combining exercise and diet, it is possible and sometimes advantageous to reduce the weight for a short time at the rate of two or three pounds a day; but it is not at all safe to continue reduction of weight at this rate for any considerable length of time. It is far better to adjust the dietary and the exercise in such a way as to secure the loss of a few ounces in weight daily, aggregating one or two pounds a week, which in the course of a few months will produce most satisfying results. If more rapid reduction of weight is undertaken by the use of drastic measures, the effort should be confined to a short period, ten days or two weeks, at the end of which time the regimen should be adjusted for slow, gradual reduction during a long period.

The effects of diet and exercise may be considerably increased by means of sweating baths followed by cold baths. The sweating bath stimulates metabolism by raising the temperature of the body, and the cold bath accelerates metabolism by increasing muscular tension, which accounts for 40 or 50 per cent. of the total energy expenditure of the body. Swimming in water at a temperature of 75° is a most excellent mode of exercise to be employed in connection with the sweating bath, the best forms of which are the incandescent or arc light bath and the sunbath, when available.

It is important to remember that body weight does not always follow closely the actual reduction in tissue. There is usually a retention of water which masks the actual tissue loss. This tendency may be met by greatly reducing the salt (sodium chlorid) of the diet, by limiting the amount of water taken, and by daily sweating baths.

In the case of obese persons who are not able to take voluntary exercise, and especially in cases in which the abnormal deposit of fat is largely confined to the abdominal region, automatic exercise renders very great service. By a method of automatic gymnastics, which the writer devised many years ago (1885) and has used successfully in hundreds of cases, the muscles may be brought into active operation and made to do actual work through the application of a painless electrical current. The rate of metabolism or tissue work and energy expenditure may be increased to eight times the normal or even more. For example, the abdominal muscles may be made to lift a weight of 75-150 lbs. two or three times a second, doing actual mechanical work equivalent to 10 to 20 foot pounds every second, 36 tons an hour, and continue to work at this rate for 30 minutes or such longer period as may be considered desirable.

Underfeeding is indicated in most cases of obesity and in cases of persons suffering from autointoxication from a too high protein diet and the excessive use of animal fats. It is the proper dietary after an attack of "biliousness" and for a person of full weight and active habits who by some accident, as the breaking of a leg or a sprain of an ankle is suddenly confined to bed. Much harm results from neglect to reduce the intake of food when the habits are suddenly changed from great activity to complete inaction from any cause. This regimen is contraindicated in cases of orthostatic albuminuria; that is, in cases in which albumen appears in the urine when the patient is in the upright position but disappears when the recumbent position is assumed. Underfeeding is indicated as an essential feature of the dietetic treatment of diabetes and is a very useful measure in many cases of gout.

THE BLAND OR NON-LAXATIVE DIET

The bland diet consists of foods which are lacking in the qualities which stimulates either secretion or motility; that is, foodstuffs which are smooth, emolient, and nearly tasteless. Condiments of all sorts are excluded, with the possible exception of salt, which may be allowed in small amount. Cane sugar and fruit acids must also be avoided. Rice gruel, oatmeal jelly, barley water, and cornstarch or arrow-root gruel, are typical bland foods. Such very bland foods are required only in very exceptional cases as acute inflammations or burns of the mouth and throat from hot liquids or chemicals, or acute inflammation of the stomach.

In general, milk may be used in combination with the foods named or even by itself. Buttermilk with rice or cornstarch is often preferable to fresh milk.

Purées of potato and other vegetables, mushes, porridge, cream toast, panada, and most breakfast cereals, are suited to cases which do not require the blandest foods. Egg nog (yolk only), curdled eggs and custards, are also allowable in many cases, as also mildly flavored jellies prepared from agar or vegetable gelatine. Malt sugar may be used when cane sugar and other sweets are not tolerated.

There is much less frequent occasion for the use of a bland liquid diet than is generally supposed. The mere fact of frequent bowel movement is by no means an indication for a bland or non-laxative diet. Frequent bowel movement is very often due to the fact that the colon is completely filled with putrefying residues, the frequent, but incomplete, evacuations being simply the overflow of an overfilled reservoir. In such cases, the feeding of bran and various other food laxatives is indicated, rather than a bland dietary. It seems doubtful, indeed, whether the slightest harm ever results from the use of a highly laxative diet except in cases of acute diarrhea or dysentery. Food is a natural and harmless laxative. Bulky food, even roughage, does not stimulate peristalsis by causing irritation, but by titillation. If more bulk than necessary is taken, the increased colon activity may cause some inconvenience, but will do no harm, for there is no infection, no inflammation, no production of toxins, and the result will be increased sense of well-being rather than malaise and weakness, the presence of which in ordinary diarrhea is the result of the absorption of the toxins produced by disease-producing bacteria and not by the frequent movements.

The bland liquid diet is most clearly indicated in cases of feeble patients who cannot chew, in patients who are too ill to chew hard or dry food, in certain surgical cases, in cases in which tube feeding is required for duodenal or gastric ulcer, sometimes in cases of insane persons who refuse to eat and must be nourished by tube feeding, and in inflammations of the mouth.

It should be remembered that, in general, a bland diet is highly constipating. In infants and in many adults acid fruit juices and malt sugar solutions have a laxative tendency. Agar jellies are somewhat laxative. Purées of figs, dates, prunes and other fruits should be used when possible, though, in general, acid and saccharine foods must be avoided. Care must be taken to cleanse the colon twice a day by means of a warm enema. When colonic irritation exists, a pint of thin warm starch solution should be introduced into the colon after each enema.

All meals should be light, and frequent feedings (four to six daily) should be given if necessary.

A diet of cereal gruels is often of greatest service in cases of intestinal infection with looseness of the bowels, especially in children, not because of its bland or non-laxative character, but because it floods the intestine with carbohydrate, a kind of nutriment which encourages the growth of beneficent acid-forming organisms and discourages the growth of the putrefactive and disease-producing bacteria which are the cause of the diarrhea. The addition of milk sugar to the diet is advantageous, hastening the change of flora and so terminating the bowel disorder.

In cases of stomatitis or after burns of the mouth and throat the rice regimen is most useful. Well cooked rice gruel or jelly will be tolerated when contact of almost any other food is painful.

CARBOHYDRATE-FREE DIET

The belief held by many, even by some physicians, that the free use of farinaceous foods is likely to give rise to certain forms of dyspepsia, gout, rheumatism and other disorders, has no scientific foundation. This doctrine, much more widely current during the latter part of the last century than at the present time, was largely due to the teaching of Dr. Salisbury, who held that the free use of starch foods led to the development of yeast in the intestine and in the blood. These migrating yeast cells he held to be the cause of tuberculosis, Bright's disease and various other maladies. He prescribed a starch-free diet, consisting largely of lean meat, for the purpose of starving out the dangerous yeast cells.

On one occasion the writer, having been called to Cleveland to see in consulation a patient who had for some time been under the care of Dr. Salisbury, had an opportunity to see a demonstration of the so-called yeast cells in the blood by an assistant to Dr. Salisbury, his nephew. The demonstration consisted of the exhibition of a mass of disintegrated white blood cells collected together and crushed by a peculiar method of manipulation, but which the demonstrator claimed to be yeast cells. The writer suggested that since yeast is a living organism and will grow if planted, this biologic test should be applied to the so-called specimen of yeast. The proposition was agreed to but never carried out.

Nothing could be more ridiculous than the theory upon which the Salisbury method was based, and it is surprising that this pernicious teaching still survives in current treatises on diet. Starch is the most easily digestible and the least likely to do injury, even when eaten to excess, of any of the several food principles.

An excessive intake of fat causes slow digestion, and soon gives rise to a condition known as biliousness, which is caused by an unusual degree of putrefaction in the colon. In children, an excess of fat is likely to give rise to acidosis.

An excess of protein overtaxes both the liver and the kidneys, and promotes intestinal autointoxication from the putrefaction of food residues. An excess of starch, however, leads to no greater damage than an undue accumulation of fat. That a farinaceous diet can in any way be responsible for gout, rheumatism, or even diabetes, is an implication against this highly inoffensive foodstuff which has no scientific support.

A carbohydrate-free diet is called for in only one class of cases, namely, persons suffering from diabetes, and then only as a temporary expedient to clear the urine from sugar by reducing the blood sugar. The prolonged exclusion of carbohydrates from the dietary is not only unnecessary but is highly dangerous, and is the most certain method of producing acidosis, a condition which is wrongly attributed to the use of carbohydrates. It is impossible to maintain the body in health without a daily intake of at least two or three ounces of carbohydrates.

FAT-FREE DIET

The researches of Hindhede show conclusively that fats may be practically eliminated from the diet without danger. He kept a man in good health for twenty-three months on a diet consisting of bread, potatoes and greens, all fat being eliminated except that naturally found in the three foodstuffs named, certainly a very small amount. Dr. Hindhede stated, however, in a letter to the writer, that the subject of his experiment found it necessary to eat large quantities of greens, doubtless to supply the needed fat soluble vitamin, lime and iron, all of which are deficient in bread and potatoes.

Persons who have a tendency to take on fat readily should avoid the use of butter and cream and should reduce the fat intake to a minimum. A certain amount of fat seems necessary to produce a sense of satisfaction, or satiety, after meals.

Those whose stomachs produce a deficiency of hydrochloric acid should avoid the free use of fats, as fats tend to discourage the production of gastric acid, as shown by Pavlov.

The free use of fats is also to be avoided by those whose stomachs empty slowly because of lack of nerve tone. Fats should be used sparingly in cases of achylia because of the tendency to intestinal putrefaction due to lack of gastric acid, a tendency which is increased by the free use of fats.

DRY DIET

(Page 856)

In this diet, the consumption of fluids is limited to fifteen ounces daily. It is recommended by Von Noorden, Oertel, and others in cases of senile heart, fatty heart, beer drinker's heart, and all cases in which there is a very pronounced myocarditis or loss of muscular tone with ascites or general dropsy and passive congestion of the liver. In the writer's opinion this severe restriction of fluids is a drastic measure which must be used with great caution and never for more than a few days consecutively. By careful hydriatic treatment the congestion of the liver and kidneys may be in most cases so far overcome as to permit the passage through the tissues of a sufficient amount of water to allow a daily intake of two or three pints. This may be accomplished by fomentations over the liver and kidneys and by the moist abdominal bandage worn continually and changed every two or three hours. If the heart is very weak, a cold compress (60° F) should be placed over the heart and chest during the application of the fomentation and each alternate hour during the day. When fluids are too long restricted, there is likely to be an accumulation of waste products in the blood and tissue fluids, the result of which is necessarily harmful.

It is highly important to remember that when the quantity of fluids is greatly restricted, salt must be withdrawn entirely (see Salt-Free Diet, page 447).

Deep breathing should be practiced hourly for two to five minutes, to aid the hepatic circulation.

The diet should consist of thin slices of well toasted graham bread with butter, baked potato, spinach, and other greens, blanched almonds, hazelnuts, oatmeal mush, boiled rice and other foods of high caloric value, with lettuce and celery. The small amount of liquid should be taken in quantities of three ounces at intervals during the day.

THE POTATO REGIMEN

The potato regimen consists of potatoes served in various forms, baked potatoes, steamed potatoes, potato soup or porridge, and potato purée. A little salt may be taken with the potatoes but little other seasoning should be added. A little cream or savora gravy is most suitable. In addition to potatoes this regimen may include greens of any sort. Among the best are New Zealand spinach, narrow or curly leaved dock, chard, beet tops, and turnip tops. Cantaloups, cucumbers, lettuce, celery, and tomatoes are also admissible.

All of these garden products are rich in soda and potash which increase the alkalinity of the blood and tissue fluids, and so antagonize acidosis and increase the solubility of the uric acid and other wastes which are likely to occur in excessive quantity in the tissues of sedentary persons and those who have been high livers and in all sufferers from chronic constipation and the resulting intestinal toxemia. Hindhede believes that by following a potato diet for some little time the size of impacted renal calculi or gravel may be diminished and that they may thus be gotten rid of. The writer has several times observed the passage of renal calculi which had lodged in the ureter, after putting the patient on a potato diet accompanied by water drinking, water being given to the extent of three or four quarts daily. This method is certainly well worth trying in cases of this sort and may be adopted in all cases of so-called uric acid diathesis.

If necessary, the potato regimen may be followed for a long time. This has been shown by Hindhede of Denmark who fed a young man exclusively on potatoes and fat for several months. In a research conducted at Columbia University by Miss Lenna Cooper, in which the diet consisted exclusively of potatoes and clarified butter, the nitrogen balance was maintained on a protein intake of only one and one-fourth calories of potato protein a day per pound of body weight, from which it is evident both that this small amount of protein is sufficient and that the protein of the potato is of very good quality.

Dr. Leipiner recently reported (1919) in the German medical press remarkable results from the feeding of dropsical patients on a potato diet.

FRESH OR RAW DIET

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Much nonsense has been talked and written by food charlatans within the last twenty years about the virtues of the raw diet. The writer has never been able to endorse the extravagant claims made by the promoters of the raw food fad, and there is no doubt that considerable harm has been done by the unscientific methods and unwarranted claims made by these false prophets whose pseudo dietotherapy has through the prejudice created greatly hindered the progress of real diet reform.

It must be remembered, however, that in his original state primitive man lived upon the products of the earth as presented by the bountiful hand of Nature in forest and field. For long ages before the discovery of fire and the art of cookery, our hardy and vigorous ancestors subsisted upon the natural products of the earth. Referring to the Golden Age "that fed on fruit, nor durst with bloody meals their mouths pollute."

"While earth not only can your needs supply,
But, lavish of her store, provides for luxury;
A guiltless feast administers with ease,
And without blood is prodigal to please."

There can be no doubt that the natural products of the earth afford all the necessary means for the sustenance of human beings as well as for other animals. Some years ago Dr. Slonaker, of the Leland Stanford University, made a feeding experiment with rats from which he drew the conclusion that human beings cannot subsist upon natural foodstuffs of purely vegetable origin; but the researches of McCollum, of Johns Hopkins, confirmed by observations made in the research laboratory of the Battle Creek Sanitarium, as well as by the personal experience of hundreds of persons now living, have fully demonstrated that life can be well sustained on a dietary consisting wholly of natural foods unchanged by any artificial process.

Butter, cream, and other dairy products may be easily eaten in the raw state. They are, indeed, for the most part habitually used in this way. To this list may be added green corn, certain varieties of which, particularly the Golden Bantam and a dwarf Mexican sweet corn, are more palatable and digestible when raw than after cooking. Wheat, when in the milk state, may also be eaten raw, and when properly served is not unpalatable. Turnips and carrots, when properly prepared, as well as lettuce, celery, cucumbers, radishes and even turnips, make very palatable as well as wholesome salads.

Milk is one of the most important of all available raw foods. Unfortunately, most of our commercial milk reaches the consumer contaminated with such a load of filth that it is scarcely safe to eat it without pasteurization or sterilization. Buttermilk, sour milk, and cottage cheese are somewhat safer than sweet milk. The best of all is certified milk, or milk produced under certified conditions.

The milk regimen owes the good results which it produces in large measure to the vitamins and food lime which it supplies.

Some of the cereals may also be eaten partially cooked. The Scotch from time immemorial have made scalded oatmeal their staple food. More than two hundred years ago a historian praised the Scotch soldiers for their wonderful endurance and military prowess which he attributed to the fact that they subsisted upon scalded oatmeal.

The Scotch method of cooking oatmeal is to place it in a pan and pour boiling water upon it, stirring it until it "sets," when it is considered ready for use. A somewhat better plan is to stir the oatmeal into boiling water. After the mixture sets, remove from the fire and allow to stand for eight to ten minutes. A mixture of equal parts of rolled oats and bran, or a combination of equal parts of corn meal, steel cut oats and bran prepared in the same way will be found excellent breakfast foods. These preparations have for years been much used at the Battle Creek Sanitarium with most excellent results.

Another excellent method of preparing rolled oats is to stir the meal into boiling water and remove from the fire at the end of one minute when prepared in this way the usual pasty quality is wholly avoided. The oat grains remain distinct like well boiled rice and may be eaten with relish and satisfaction.

The American method of cooking oatmeal until it becomes a pasty mass is doubtless responsible for much chronic indigestion and is particularly promotive of constipation. When cooked in the manner above described, oatmeal becomes an excellent laxative food as well as an efficient means of promoting the growth in the colon of the protective organisms which Nature implants in the intestine at birth and which are lost by errors in diet and neglect to evacuate the bowels with normal frequency and thoroughness.

A special virtue of the uncooked dietary which was never recognized or even suspected by its advocates, and to which the writer first called attention some years ago, is due to the fact that uncooked starch is digested less readily than cooked starch and hence is less rapidly absorbed. As a result, when cereals are eaten in an imperfectly cooked state a certain proportion of the raw starch reaches the colon where its presence is greatly needed to encourage the growth of the lactic acid forming organisms, and thus prevent the putrefactive processes likely to be active in this part of the intestine.

Recent experiments by Langworthy and Deuel (1920) show that raw potato starch is digested much more slowly than the raw starch of wheat, oats and rice. So large an amount as six ounces of raw wheat starch or eight ounces of raw corn starch was found to be completely digested, whereas, when six ounces of raw potato starch was given with other food, nearly one-fourth of it was found undigested in the stools. The interesting fact was noted that the raw potato stools when burned gave off no fecal odor, the odor resembling that of scorched bread.

The uncooked eggs often included in the raw diet destroy the chief advantage of this regimen, since the raw white of egg is known to be indigestible in the human alimentary canal, at least in large part, and hence must greatly encourage putrefaction in the colon.

A diet consisting wholly of fresh, uncooked fruits, vegetables and cereals greatly aids intestinal asepsis. This diet aids the change of flora and is most efficient in maintaining the change. Acidophilus buttermilk may be advantageously used.

While not to be recommended as a steady diet, the fresh or raw regimen may be resorted to temporarily as an aid in combating intestinal toxemia, constipation and obesity, for short periods as a wholesome change. The adoption of such a diet is by no means a hardship to one who does not mind taking the trouble to supply himself with the numerous varieties of delicious fruits, nuts, and fresh vegetables which are now available at almost any season of year.

RECTAL FEEDING

Rectal feeding renders great service in a variety of conditions, particularly in cases of obstruction of the esophagus, inoperable cancer of the cardiac orifice or of the pylorus, in cases of ulcer of the stomach or duodenum, particularly when hemorrhages are present, and in cases in which the patient is unable to swallow because of coma, or because of obstruction of the mouth as the result of a burn or other injury. In certain cases of great emaciation with very feeble digestion, but with absence of appetite, rectal feeding renders service.

The use of a long rectal tube is not necessary. It presents no advantages. If the food mixture is warm, 100° to 102° F, and if it is introduced slowly, not more rapidly than six or eight ounces a minute, the nutritive material will readily find its way from the rectum to the cecum. A long rectal tube offers no advantages for the reason that it cannot be passed into the bowel for more than a few inches and invariably coils up in the rectum. Only by means of the proctoscope can a tube be passed more than 6 or 8 inches into the bowel, and fortunately this high intubation is not necessary.

There has been much discussion concerning the ability of the colon to digest or to absorb nutrient material, and on this account it has been the usual fashion to use for nutritive enemata, pancreatized milk or fresh pancreas suitably prepared. The writer is very doubtful whether the addition of pancreas or pancreatic products is likely to be of any material service. In the writer's opinion, nutritive enemas are of little value unless given in sufficient quantity, not only to fill the colon but to pass the ileocecal valve and enter the lower part of the small intestine. It is more than probable that this happens in those cases in which the patient appears to be well sustained or even to gain in flesh during rectal feeding. Incompetency of the ileocecal exists in a large proportion of chronic invalids and in not a few instances is unquestionably a factor in the production of chronic disease.

Rectal feeding is, then, not so very different from ordinary feeding. The small intestine is the principal organ of digestion and absorption. The stomach and the colon are organs which have comparatively little to do with digestive work. The stomach absorbs almost none at all and the colon also absorbs comparatively little. The small intestine is the great absorbing as well as the great digestive organ. It absorbs liquids daily to the extent of six quarts or more, while the colon absorbs scarcely one-tenth as much. The body is fed when food is introduced into the small intestine either at its upper or lower end.

In general, it may be said that malt sugar is about the only food the absorption of which, through the colon, can be depended upon. This carbohydrate may be absorbed and utilized without undergoing digestion, whereas fats and protein require digestive changes which cannot be effected in the colon. Most of the benefits which can be derived from the nutritive enema may be secured by copious injections of solutions of malt sugar, two ounces to the pint. Six or eight pints should be administered daily. The solution should be at the temperature of the body, and should be introduced slowly, the patient lying down and remaining quiet for half an hour after the introduction of the solution so as to afford opportunity for absorption.

It is an excellent plan to make use of vegetable broths, such as bean broth, vegetable bouillon and solutions of yeast extract, (Savita, Marmite). By this means, vitamins and food salts, which are highly necessary, may be supplied.

Nutritive enemas consisting of raw eggs, meat juice and animal broths, probably do more harm than good. They encourage the growth of putrefactive organisms, which give rise to putrefaction products, and so increase the burden of toxins with which in a large percentage of cases, the patient is already overwhelmed. Malt sugar solutions encourage the growth of acid-forming organisms, which discourage putrefaction and thus help to change the intestinal flora.

In the employment of rectal feeding it is necessary, first of all, that the colon should be properly prepared. To this end the colon should be thoroughly washed out by a cleansing enema half an hour before the feeding takes place. Suitably prepared foods should be administered at intervals of three or four hours during the day. A good plan is to feed at 7:00 A. M., 11:00 A. M., 3:00 P. M., and 7:00 P. M.

Care must be taken to see that a sufficient amount of liquid is taken and retained. The amount required is at least two quarts daily. The amount of urine will be a good measure of the amount being absorbed. The quantity of urine should not fall below one quart.

Patients sometimes suffer from irritation produced by the frequent introduction of the tube into the anal canal. This difficulty may be obviated by lubricating the tube with yellow carbolated vaseline. Care should also be taken to cleanse the anal region thoroughly after each evacuation, using soap and water for the purpose. Absolute cleanliness is the best preventive of fissure and other anal troubles arising from mechanical irritation.

INTRAVENOUS FEEDING

Intravenous feeding is now practiced with great success in certain cases. This method consists in the injection into a vein of a suitable liquid containing sugar (pure glucose).

The services of a surgeon are, of course, required and the most perfect asepsis is necessary.

By intravenous feeding, acidosis may be successfully combated when not amenable to any other measure. It is a precious resource when feeding by any other method is impossible. Its chief service is rendered in surgical cases when the condition of the patient is such as to require quick reinforcement of the vital energies by an intake of food.

WATER DRINKING

Water drinking as a therapeutic measure is of very ancient origin. Hippocrates prescribed water drinking as a remedy in fevers, and the drinking of cold water has been practised among the Egyptians from the most ancient times in the treatment of fevers. Cold water drinking was used by Hahn in the treatment of fevers in Germany in the first half of the eighteenth century, fully sixty years before Priessnitz prescribed the internal use of water in massive doses at Graefenberg.

Todano, an Italian contemporary of Hahn, made his fever patients drink five pints of ice water every three hours. The patient was placed in a hammock without covering, and the treatment was continued until perspiration occurred. This extraordinarily vigorous refrigerative treatment must have sometimes produced undesirable results, and it is these excesses in the use of an efficient and valuable remedy which are doubtless to a great degree responsible for the slowness with which the merit of water drinking as a systematic procedure has acquired recognition and appreciation.

The importance of water to the vital economy must be recognized when we remember that the living organisms which compose the human body, as well as those of all other animals, are submerged in water.

Bernard, the great French physiologist, sagaciously remarked concerning the aquatic life of man, "Life exists only in a liquid medium. It is only by certain artifices of construction that the organisms of man as those of other animals, can live in the air; but all the active cells upon which their functions depend, live, without exception, like the infusoria, in an interior liquid medium."

Water drinking is an internal bath; it dilutes the fluids of the body in which the cells and fibers are bathed; it purifies the body by diluting the medium in which it lives. By the free use of water the movements of the mass of liquid in which the living elements of the human body perform their work are quickened, and the stream of life runs clear and pure. It has been shown that water is absorbed from the stomach very slowly. Absorption takes place chiefly in the intestine. Absorption is stimulated, moreover, by the presence of carbon dioxide gas. The presence of mineral salts of any kind lessens the rate of absorption.

Examination of the urine shows not only that the quantity is increased by water drinking, but that the urea and other solid constituents are also increased.

Baron Liebig showed long ago (and his observations have been many times confirmed) that water drinking powerfully influences metabolism, increasing both assimilation and disintegration, but especially the former.

When the amount of water supplied to the body is insufficient, the condition of the body becomes in some degree comparable to that of a stagnant pool; while an abundant supply of liquid so encourages its activities that it may not inaptly be compared to the flowing mountain stream. Water is not a mere mechanical conveyor of poisons out and of food in; it is a powerful vital stimulant.

Priessnitz, of Gräfenberg, required his patients to drink large quantities of water, many patients taking as high as twenty to forty glasses a day. The deluging practice of Priessnitz is still recommended by the German water-cure empirics and by some hydrotherapists, but cases are certainly very rare in which such quantities of cold water can be swallowed with advantage. As a measure of treatment, water drinking may be generally practiced to the extent of six or eight or even ten glasses a day with advantage, when required, but not infrequently three or four glasses are sufficient, and there are cases in which it is more important to interdict the use of liquids by the stomach than to commend their use. In such cases water may be introduced by the enema in small quantity, to be retained.

Water drinking is especially indicated in all the cachexias and diatheses. In *rheumatism*, it is useful as a means of diluting the blood so that it can dissolve and carry out of the body a larger amount of waste matters. As a means for encouraging activity of the skin and kidneys, it is always useful in this disease.

In *diabetes*, the free use of water is not injurious, but advantageous. The blood contains an excess of sugar. All the sugar that is not oxidized must be removed from the body by the kidneys. The specific gravity of the urine in these cases is always high, indicating a similarly high specific gravity of the blood. It is evident, then, that water is needed in cases of this sort for the purpose of maintaining a proper degree of fluidity of the blood and of facilitating the removal of the unused sugar, the presence of which interferes more or less seriously with the various vital functions.

Free water drinking is also important in diabetes to aid in the elimination of acetone and diacetic acid, and in preventing acidosis. Free water drinking in cases of acidosis and diabetic coma is highly important. While the free use of water in diabetes will, of course, have the effect to increase the quantity of urine daily discharged, the amount of sugar, which is a matter of most serious importance in this disease, is not increased. Indeed, the amount of sugar has appeared to be somewhat decreased, and sometimes greatly lessened, doubtless as the result of the increased oxidation which takes place within the body under the influence of free water drinking.

In *diabetes insipidis,* the disposition to drink large quantities of water should be resisted to a moderate extent, water being taken only when the thirst becomes very intense.

In *fevers,* water drinking is essential as a means of aiding the kidneys and the skin in the elimination of the toxins to which the rise of temperature is due, in aiding the liver in its work of destroying the fever poisons, and promoting the reduction of temperature by causing increased evaporation from the skin.

Water drinking is of the highest importance in the treatment of acute infectious diseases of all sorts. The paralysis which sometimes occurs as a complication of diphtheria and typhoid fever and which regularly makes its appearance in poliomyelitis, as well as the nephritis which may appear in severe acute cases in nearly all of the acute infections, are due to the bacterial toxins characteristic of these disorders. The safety of the patient depends upon the rapid elimination of these poisons. This can best be encouraged by copious water drinking, which not only lessens the intensity of the effect of the poisons by diluting them, but promotes in the most effective way possible their elimination.

For a small child of two to four years, the rule should be an ounce of water every half hour, the total given each twenty-four hours amounting to not less than one quart. For a child of five to eight years, two ounces should be given every half hour. For a child of twelve years and upwards, the amount should be not less than four ounces every half hour, or half a pint per hour. In addition, an enema should be given twice a day. If the bowels move, as they should do, a second enema should be administered immediately afterward, a considerable part of which should be retained. The size of the first enema should be one to three pints, according to the age of the individual, or half a pint in a child of three or four years. The quantity of the second enema should be about half as much.

When the proper amount of water is being given, the fact will be made evident by a copious flow of urine. If the urine remains scanty and high colored, the fact is almost conclusive evidence that the patient is not receiving the proper amount of water.

Fruit juices of various sorts may be added to the water to render it more acceptable to the patient. In most cases much less difficulty will be experienced in giving a small quantity of water frequently than in giving a larger quantity at one time. In certain cases the water may be given in teaspoonful or dessert-spoonful doses, repeating every few minutes.

In cases of *chronic inactivity* of the *skin,* cold water drinking is an exceedingly valuable measure, but it must be employed with discretion, as inactivity of the skin generally means an inactive mucous membrane, so that liquids are absorbed with difficulty.

In cases of pyloric obstruction, intestinal obstruction or persistent vomiting, water drinking, while indicated as a means of relieving the general condition, is inadmissible, and water must be introduced by way of the rectum, using either small enemas or the "drop method."

Copious water drinking is one of the most effective means of relieving a *common cold,* by aiding in the elimination of tissue poisons, the accumulation of which gives rise to the difficulty known as a "cold."

One or two glasses of cold water taken half an hour or an hour before breakfast prove in many cases an almost perfect panacea for *chronic inactivity* of the *bowels.* At a meeting of the New York Academy of Medicine, attended by the author many years ago, a leading physician of New York City stated that he had successfully treated more than one hundred cases of constipation by this simple means.

Chronic biliousness, which is nothing more nor less than *chronic toxemia* resulting from the putrefaction of food residues in the colon, requires the free use of water. Eight or ten glasses a day would be none too much in cases of this sort and the colon should be cleared by an enema twice a day. The flora must be changed.

In cases of *gall-stones* and *infectious jaundice,* water drinking is certainly indicated. The amount taken should be ten or twelve glassses a day, if possible, so that the liver shall be thoroughly flushed.

In *cirrhosis* of the *liver* arising from either indigestion or alcohol, water drinking is essential as a means of aiding the liver and the kidneys to perform the work required of them in the removal of the large quantity of colon poisons in addition to the wastes naturally produced within the body by the physiological processes of tissue change.

In the treatment of the opium, alcohol, tobacco and other *drug habits,* water drinking renders important service by hastening the elimination of the drug and in aiding liver work and general oxidation.

The *temperature* of the water drunk should ordinarily be about 70° F. In special cases water at 60° and even 50° may be employed. Very cold water is indicated only in fevers, in constipation, and in small quantities in hypopepsia.

The *quantity of water* taken must depend on the effect desired. In fevers, a good rule is to take a glass of water every hour. In hypopepsia, one-third or one-half a glassful of cold water may be taken half an hour before eating. For inactivity of the bowels, one or two glasses of cold water should be taken on retiring at night, and as much more on arising in the morning. A thirst for water is almost always an indication that it may be taken with advantage, no matter whether such use is in harmony with the established canons of hygiene or not. It must be remembered, however, that when water drinking is indicated it should be taken without reference to the sense of thirst. Not infrequently thirst as well as hunger is absent, although both food and drink may be greatly needed. It is safer to trust to the natural instincts than to pin one's faith to a theory. Almost the only decided contraindication is in connection with meals, when free water drinking prevents proper insalivation of the food.

Whenever water drinking is employed as a therapeutic measure, all the urine should be collected daily and carefully measured. In general, the amount of urine should be not less than half the total amount of water taken, or equal to the amount of water taken as such. When a large amount of water is taken, the proportion passed as urine will be greater. Aside from liquids taken at meals, the food should be reckoned as about three-fourths water. Patients often think they drink more than they do. The actual measurement of the urine is necessary as a check. When the skin is very active as the result of exercise or exposure to heat the amount of urine will of course be diminished, and the intake of water must be increased so as avoid the injury which comes from exposure of the kidney tissues to a concentrated solution of tissue wastes and other poisons.

Minkowski has shown that, in general, the amount of water taken daily should be such as to maintain a daily output of urine amounting to three or four pints.

An excess of water may give rise to a marked increase in blood pressure, and in cases in which the kidneys do not eliminate water readily, may encourage dropsy.

When the patient cannot be made to swallow a sufficient amount of water, and introduction of water through the colon fails, a duodenal feeding tube may be used with advantage. As much as ten quarts of water have been introduced daily for a week by this method under the writer's supervision.

The purest water is universally the best. Whatever beneficial effects are obtained from water drinking must be attributed to the water itself, and not to any ingredients which it contains. Mineral waters are simply diluted drugs. The ingredients may be obtained at any drug store, and if diluted to the same extent as that in which they are found in the so-called natural waters, the effects obtained from their use would be the same. Medical experience has shown that the best of the so-called mineral waters are those which contain the least mineral ingredients. The very best water is distilled water which has been well aerated. Water obtained from natural sources is generally more or less contaminated, that from lakes, streams, and rivers being necessarily defiled by the fish and other creatures which live in natural bodies of water, and by surface drainage, which, after every rain, washes in quantities of filth.

In general water obtained from public supplies should be boiled; this precaution is a wise one under nearly all circumstances.

Hard water should always be boiled for a long time to eliminate, so far as possible, the lime which it contains.

HOT WATER DRINKING

Hot water drinking is an excellent means of cleansing the stomach. The stomach, like every other cavity of the body which is exposed to infection from the exterior needs constant and thorough disinfection.

The mouth is cleansed by the saliva and buccal mucus which not only sweep away the germs which enter the mouth from the air and in the food, but when produced from clean, healthy blood possess the remarkable property of hindering the growth of germs even though not able to actually destroy them.

In addition to this there is an active destruction of germs by the white blood cells which enter the mouth in great numbers with the several salivary secretions and the secretion poured out by the mucous glands of the mouth.

Those wonderful cells, the phagocytes, are always present in the saliva which bathes the gums and the teeth and when examined under the microscope may be seen to be filled with germs which they have captured and destroyed.

The stomach is disinfected in a similar manner. Healthy gastric juice contains free hydrochloric acid which is a powerful disinfectant. The stomach produces daily from one-third to one-half ounce of pure hydrochloric acid.

The hydrochloric acid, aided by pepsin, not only digests the food but disinfects it, and after the food leaves the stomach, the gastric acid disinfects the stomach itself. This is highly important as a preparation for the next meal.

Hence it is necessary that the stomach should become empty and should have a short period of rest after each meal before food is again taken into the stomach. This will prepare the stomach not only by insuring perfect freedom from infecting bacteria but by giving the glands of the stomach and the nerve centers which control its action an opportunity to replenish their energy for the digestion of another meal.

The stomach should have a chance to rest for one hour after each meal before the taking of the next. If food is received into the stomach before it has disposed of the previous meal, there is no chance for either rest or disinfection. The stomach is unprepared to do its work well and indigestion is the result.

A healthy stomach empties itself of an ordinary meal in three and a half to four hours; and so the usual meal hours, 7:00 to 7:30 A. M., 12:00 M. to 1:00 P. M., and 6:00 to 6:30 P. M., afford time for rest and disinfection as well as digestion.

But when the stomach becomes disordered so that it does not empty itself promptly, the meals overlap, the stomach is cleared only once during the day, namely, during the night; the gastric glands become worn out with overwork, the mucous membrane of the stomach becomes infected and diseased and serious gastric disorders result.

This condition is exceedingly common among chronic invalids. There are very few persons suffering from chronic disease of the heart, blood-vesssels, kidneys, liver, or nerves, who do not at the same time suffer from some disorder of the stomach or intestines.

Two or three glasses of water should be taken four hours after each meal, the time when the stomach should be emptied of the last remnants of the last meal. The temperature of the water may be hot or 105 to 110 degrees F.

The quantity of water taken should be about a pint, and the best time for taking is about an hour before eating.

Lavage of the Blood and Tissues.

Flushing and washing of the blood and tissues may be accomplished by means of the duodenal feeding tube. The tube may be left in place for several days, and water may be passed in almost continuously at the rate of one and one-half pints an hour, or two or three gallons daily. The result is very free diuresis and often large watery stools. By addition of milk or malt sugar in proportion of one or two ounces to the pint any desired amount of carbohydrate food may be introduced.

GAVAGE

Feeding by means of the stomach tube or duodenal feeding tube sometimes proves to be a highly practical and successful measure of treatment. It is especially valuable in cases of gastric or duodenal ulcer, as it affords the stomach and upper duodenum an opportunity for rest. The amount of food given at each feeding should be small, not more than 3 to 6 ounces. The feeding should be repeated every two hours and the food should be introduced very slowly. In many cases the quantity should be reduced to a half ounce or an ounce and the feeding should be repeated every 30 or 40 minutes. The ideal method is almost continuous feeding by means of a syphon, which the patient can be taught to manage for himself.

The following formula has been much used by the writer and his colleagues in duodenal feeding:—

Malted milk or malted nuts	1¼	oz.
Malt sugar	¼	"
Cream	1	"
Water to make	6	"
Calories	221	

To be given six times a day at two hour intervals (6 × 221 = 1326). After one week, increase amount of feeding to nine ounces, which will aggregate approximately 2000 calories.

When duodenal feeding is relied upon for more than two or three days, care should be taken to include suitable iron-containing foods in proper quantity. Yolk of egg hard boiled and rubbed smooth and purée of spinach are best for this purpose. Four to six ounces of spinach and half a dozen egg yolks are required daily to supply the iron and vitamins which are especially needed in these cases. Malted nuts may be advantageously used when milk does not agree and especially in cases of anemia, this preparation containing a good percentage of iron, which is deficient in malted milk.

DIET IN DIGESTIVE DISORDERS

Most diseases of the digestive organs are the result of errors in diet or in eating habits: it is evident, then, that in diet and regimens are to be found the most efficient remedies for disorders of this class. It must be borne in mind, however, that the modes and times of eating and the quantities of food eaten are matters equal in importance with the quality of food. In individual cases, in fact, any one of the factors named, may be the dominant influence in causing the particular disturbance present.

Furthermore, it is important to note the fact that other factors besides food profoundly influence the digestive process. The woodchopper, or the athlete, is able to manage without difficulty a dietary which would paralyze the digestive powers of a judge or a college professor. Yet there are sedentary persons who are blessed with such extraordinarily vigorous digestive organs, that for many years they are able to disregard every principle of rational dietetics with apparent impunity. But judgment day is certain to come at last. These exceptional persons may escape the miseries of ordinary digestive disturbances, but Bright's disease, cancer, apoplexy, premature senility, or some other degenerative disorder, will sooner or later appear as the penalty of their unbiologic conduct.

Exercise, cold bathing and hydrotherapy in other forms, out-of-door life, and biologic or rational living in all particulars, are measures which must be faithfully employed in connection with regulation of the diet in all cases of gastric or intestinal disease.

DIET IN CONSTIPATION

In recent times the colon has been the subject of much controversy. The question is, shall it be removed? or reformed? Anatomists have declared the colon to be a useless appendage, a vestigial remnant left over from a prehistoric state. Bacteriologists have charged it with being an incubating chamber of poison-forming germs, a hold of unclean and hateful parasites, a veritable Pandora's box of disease and degeneracy. Surgeons have removed the offending organ, and thus proved that it may be dispensed with, and have claimed wonderful advantages from this abbreviation of the primæ viæ.

Barclay Smith, the great English anatomist, first suggested the uselessness of the colon. Metchnikoff proved that animals that possess the longest colons have the shortest lives, and announced that the colon bacillus is the germ of old age. Sir William Arbuthnot Lane, the eminent London surgeon, cites a long list of grave maladies, ranging from tuberculosis to rheumatism, cured by removal of this offending organ.

In the treatment of every chronic disease, and most acute maladies, the colon must be reckoned with. That the average colon, in civilized communities, is in a desperately depraved and dangerous condition, can no longer be doubted. The colon must either be removed or reformed. From the beginning of the colon controversy and for many years before, the writer has been a very earnest student of the questions involved, and has formed very definite opinions, the validity of which he, together with his colleagues of the faculty of the Battle Creek sanitarium, has had opportunity to test in the treatment of many thousands of sufferers from colon and colon-caused maladies. The writer believes that methods have been worked out by means of which the colon may be reformed and made to do its work efficiently, not only in ordinary cases, but in by far the great majority of those cases which are thought by enthusiastic colon surgeons to be suitable subjects for surgical treatment.

Until very recent years almost nothing has been known of the physiology of the colon. This part of the body has been almost a *terra incognita*. The physiology of digestion stopped at the ileocecal valve. How the colon dealt with its contents, how the very necessary act of defacation was performed, nobody knew. The discovery of the X-ray enabled Cannon and, later, Hertz to study the colon while in action in animals and man. Elliot, Keith, and other anatomists studied the intestine in dogs, and finally Case, by perfecting the X-ray technic of colon examinations, completed the physiologic study of this previously neglected organ. The combined result of the extensive labors of these investigators has been a great flood of light upon one of the most obscure questions in physiology. These new facts, not yet known to the general public, have rendered the greatest service in the development of rational methods of dealing with that most common and most destructive disease of civilized peoples—constipation.

Forty years' experience and observation in dealing with chronic invalids, and careful study of the results of the modern X-ray investigations of the colon, together with observations made at the operating table in many hundreds of cases, have convinced the writer—

1. That constipation with its consequences is the result of the unnatural habits in relation to diet and colon hygiene which prevail among civilized people.

2. That patients are not constipated on general principles, but that there exists in every case of constipation some particular condition which is the immediate cause of the delayed intestinal movement, and which must be removed before definite relief can be obtained, and that in the great majority of cases this cause is some real and tangible difficulty which may be removed by changing the intestinal flora or by other available means.

3. That practically every case of constipation is curable, and in all but exceptional cases without the aid of surgery. It must be added, however, that by cure is not meant the working of such a miracle that the colon will perform its function normally without attention to diet or other means which encourage colon activity, but rather that by observing certain rules and the faithful and continuous use of safe and simple means, the colon may be made to perform its functions in a regular and efficient manner, and without the use of irritating laxative drugs.

Constipation, though aggravated by errors in diet, is by no means wholly due to this cause, hence it must not be expected that by means of dietetic means alone all cases of constipation are curable. It is certainly true that food is the natural laxative. The act of taking foods stimulates peristaltic activity and it is more than probable that if from the start an individual adhered closely to the proper dietary eaten in a proper manner, and took care to attend promptly to the call of Nature, the normal intestinal rhythm would be maintained. These conditions, however, very rarely exist, and in consequence constipation is so nearly universal that the average individual feels himself the proud possessor of a normal colon if his bowels move once in twenty-four hours, whereas the savage declares himself to be "horribly constipated" when his bowels move but once a day. Normal bowel rhythm unquestionably demands at least three evacuations daily.

The alimentary canal is long in man, ten times the length of his body. The colon is also long and sacculated like that of herbivorous animals. This fact predisposes him to constipation, which becomes inevitable under the ordinary conditions of our modern, civilized life. Constipation is universal among civilized people. A large proportion of the people of the United States are habitual users of laxatives of some sort. Cathartic or laxative pills, aperients, liver regulators, and mineral waters are manufactured and used in enormous quantities, more extensively than any other drugs. Thousands of men and women who congratulate themselves that they are in good health because their bowels move regularly once a day, are nevertheless suffering from chronic intestinal stasis; that is, stagnation of the food residues and body wastes in the colon. The colon of a person whose bowels move once daily is constantly filled with putrefying residues which are retained in the body from two to three days undergoing decomposition and flooding the body with putrefaction products instead of being dismissed in 15 to 20 hours from the time the food was eaten, which is the normal intestinal rhythm.

Modern studies of the physiology of the colon have demonstrated that the bowels should move at least three times a day, or once after each meal. An intake should naturally be followed by an output. Normally, no putrefaction occurs in the colon or in any part of the alimentary canal. When the food residues are dismissed from the body with normal promptness, there is no time for putrefaction, the stools are yellowish in color and are free from the putrid and loathsome odor which are the usual characteristics of the stools of the average individual.

Attention must be called to the fact that a person who has suffered from chronic constipation for many years, has a colon so badly crippled that a dietary which would secure normal movements in a person possessed of a normal colon, may be found inefficient. Thoroughgoing measures alone will succeed. These will include a very liberal supply of roughage, much more than a normal colon would require, and in addition copious lubrication, which is quite necessary for the reason that in the crippled colon, mucus, the normal lubricant, may be largely lacking, owing to the destructive action of colitis upon the mucus-secreting glands. These chronically crippled colons often present a mucous surface so dry that fecal matters adhere to it, and the food residues are pushed along only with the greatest difficulty.

A person suffering with chronic constipation should first of all take the carmine capsule test for the purpose of determining the motility of his intestine; that is, the time which elapses between the taking of a meal and the discharge of the unusable residues from the body. (For a description of this test see p. 518).

The next step is to follow faithfully the laxative regimen. (See p. 580).

The third step required is a change of the intestinal flora, for it is quite impossible to secure regular and efficient activity of the colon without first restoring the normal, protective, acid-producing organisms, since the acids developed by these beneficent bacteria are the natural and necessary stimulants of the colon, as pointed out by A. Schimdt, many years ago. (For the method of changing the intestinal flora, see p. 552).

Cellulose is the chief laxative element in foodstuffs. Being indigestible, it gives to the alimentary residues, when present in sufficient quantity, the bulk necessary to excite the muscular sense of the intestine and so give rise to the peristaltic contractions by which the unusable residues and body wastes are transported through the colon and discharged from the body. Cellulose is found only in vegetable foodstuffs; hence animal foods of all sorts, meat, eggs, and dairy products are constipating. Being wholly digestible and absorbable, they leave behind little residue. But the small residues are of these animal substances which reach the colon readily undergo putrefaction, and the products of putrefaction being alkaline, paralyze the colon, which is rendered inactive by alkalies and stimulated to activity by acids.

In addition to increasing the bulk of the food, lubrication is usually required. This may be secured by the use of paraffin in some form. The Russian paraffin oil renders the most valuable service in these cases. Examination of the bowels and rectum generally shows, in cases of chronic constipation, a dryness of the mucous membrane. By the use of paraffin oil, which is not a food, undergoes no change and acts merely as a mechanical agent, the mucous surface is so lubricated that the fecal matters do not adhere, but slip readily along, even when redundant development may have given rise to folds and kinks which are more or less obstructive, or when adhesions exist that offer mechanical obstacles to the progress of the alimentary residues along the colon. Half an ounce to an ounce of heavy white Russian oil should be taken at each meal.

By the application of the two measures above outlined, a low protein diet and some simple means for accelerating movement along the alimentary canal, putrefactive processes in the intestine may be controlled to a wonderful degree and the number of bacteria may be greatly reduced. For best results, either bran or agar and the lubricating paraffin should be mixed in the entire meal instead of being taken before or after the meal or at some other time, as just before retiring at night. It is the meal itself which needs the roughage and the lubrication. These physiological aids to bowel movement do not act by irritation but by promoting physiologic action.

This method of taking bran or agar and paraffin has been found by experience to be highly important. The method must be insisted upon in obstinate cases, for the reason that the food is not thoroughly mixed together in the digestive organs, as might be imagined, but, unless readily soluble, like sugar, or a fruit acid, the foodstuffs pass along down the intestine in practically the same order in which they are eaten. If bran or oil are taken before the meal, they proceed before it; or, if taken after, they follow along behind. For best results, it is essential that these helps to colon activity should not only accompany a meal, but each part of it. Otherwise, efficient bowel action may not occur. The oil, especially, will be likely to be discharged by itself, thus giving occasion for unfortunate accidents and often much inconvenience, and the food residues, often including bran or agar, when these are used, are likely to remain behind in the cecum, which is often crippled badly by overstretching and adhesions, thus becoming a sort of cesspool, in which putrefying refuse may be retained for days in succession.

In persons whose colons are badly crippled by disease, through adhesions of the cecum or pelvic colon, and in cases of spastic constipation, the use of paraffin oil in connection with bran or agar is essential in addition to the use of laxative foods. Agar and paraffin oil should not be regarded as medicines. They are not drugs in the ordinary sense. Agar is a form of cellulose similar to that found in many foodstuffs. Paraffin oil is simply a mechanical lubricant. It has no resemblance to ordinary oils and fats except in appearance. It is a mineral product. It undergoes no change in the alimentary canal and is not absorbed. When properly refined and purified it may be used for an indefinite period without liability of injury, and in most persons who have suffered long from obstinate constipation the continued use of bran and paraffin or agar and paraffin is as much a necessity as the regular and continued use of foods. These substances should be regarded as supplementary foods.

Paraffin should be taken *with* the meal and not *before* or *after*. It should be taken in divided doses so as to be distributed through the meal and thoroughly mixed with all the food eaten. It is the food which needs to be lubricated, not the intestine. If the intestine is lubricated, the mucous secretion always forming will quickly remove it. If the food is lubricated, the lubrication travels with it and facilitates its movement along the intestine. In its ordinary form, paraffin cannot be easily taken with food; but in emulsion diluted with water or milk, it may be easily taken. Paraffin tablets, a form of paraffin which is solid at ordinary temperatures but melts at the body temperature, is also easily taken in divided doses with food. In this form, paraffin is much more efficient than in the liquid form and does not "leak," a property which removes one of the greatest objections to the use of paraffin.

What has been said of paraffin is equally true of agar, bran, and roughage in general. Bran, agar, or greens of some sort, must be taken at every meal, and should be taken in divided doses so as to be mixed with the whole meal.

The Use of the Enema. In certain cases of constipation the colon is so crippled that it cannot be readily made to assume its normal rhythmical action. In some such cases, very few, however, an operation of some sort may be needed to relieve stricture, adhesions, or some other obstacle, but in the great majority of these cases by the proper use of the enema in connection with proper diet and the other measures named the colon may be trained to do its work in a fairly normal manner. In these cases the enema must be used regularly and daily. The best time is just before retiring at night, and the hour should be approximately the same daily. About three pints of warm (102° F.) water should be used, never more than four pints. The enema may be repeated if necessary to completely empty the colon which is essential. After emptying the colon a cool or tepid enema, 80° to 70° F., should be used, quantity one pint. This will "tone" the bowel and prevent any possible injury from the use of this measure. The evening enema will not necessarily interfere with the after breakfast movement the next day and will prevent the overnight absorption of putrefaction products and overdistension of the colon with gas.

When the ordinary enema does not empty the colon, it is useful to add some harmless colon stimulant. A natural stimulant of the colon is provided by Nature in the acids produced in the normal colon by fermentation. These are lost when putrefaction takes the place of fermentation and the ammonia and other putrefaction products which take their place, poduce paralysis of the colon. These constipating poisons may be neutralized by an acid enema. This method occurred to the writer many years ago (1899) and has been used in hundreds of cases with much satisfaction. Either citric or lactic acid may be used. The amount required is the juice of one lemon or one dram of lactic acid.

Dr. Winfield, of Brooklyn, New York, has published (1912) an account of the successful treatment of psoriasis by irrigation of the colon with lactic acid. Of 40 cases treated, 23 were reported cured, 16 improved.

In cases in which the measures above indicated do not secure prompt relief from constipation, an X-ray examination by the aid of the barium meal should be made. By this means, a minute inspection of every part of the intestine is possible. In many cases, contractions, adhesions, displacements, and other impediments to normal bowel action are found, which may be corrected by the application of special measures. Such an examination should be made in all cases of obstinate constipation.

Food wastes should never be retained more than twenty-five or twenty-six hours at the longest, and the normal period is probably sixteen hours or less. Longer retention results in putrefaction and toxemia (see p. 518).

Constipation is one of the greatest causes of disease, misery, inefficiency and premature senility, and should be most earnestly combated. By a persevering effort and the application of known and well tested measures, *every case of constipation may be relieved.*

One of the most obstinate forms of constipation and one of the most common is the constipation which accompanies colitis. This form of constipation derives its name from the fact that its cause is a spastic or continuous contraction of the colon, usually the descending and pelvic colon. Because this condition accompanies colitis, it is often thought by many that bran and other roughage should be avoided. This is entirely an error. Roughage is more needed in this form of constipation than any other. Bran is of signal benefit in these cases. It is most important that the mucous membrane should be kept clean. For this reason the colon should be emptied once or twice a day by a hot enema, which will not only cleanse the bowel, but will also relax it. The diet should contain an abundance of bran or agar and other roughage, which is needed to stimulate the dilated right portion of the colon to efficient activity. Paraffin oil is necessary as a lubricant, as long continued catarrhal inflammation causes degeneration of the mucous glands and a loss of the normal lubricating mucus.

In general, the diet should be the same as in ordinary constipation.

Rules for Care of the Colon to Combat Constipation.

First of all, change the flora and then,

1. Never neglect a "call". Visit a toilet at once even at much inconvenience. A lost "call" is not easy to recover.

2. Train the bowels to move three times a day. After breakfast, after dinner or luncheon, and before retiring are the times when residues are ready for dismissal. If an extra movement occurs before breakfast, so much the better. 4 altogether

3. Visit the toilet at regular times even if no "call" is present.

4. Take plenty of time at the toilet. Read the morning paper. Crippled colons move slowly.

5. Place a footstool eight inches high in front of the toilet seat. Squatting is the normal position during evacuation.

6. Deep pressure with the fist just above the left groin often aids movement.

7. The meals must be regular to make the bowels regular. Don't miss a meal. Eat something if only an apple or an orange or two.

8. Take plenty of time to eat. Chewing the food stimulates the colon to push the residues along.

9. Eat no white flour bread and avoid condiments, meat and other constipating foods.

10. Eat whole grain breads and cereals. Add an equal measure of bran to oatmeal and other cereals. Eat liberally of greens, fresh vegetables, dates, figs, prunes and all laxative foods.

11. An orange or an apple at bedtime aids the morning evacuation.

12. Drink a glassful of cold water at bedtime, on rising in the morning and every time the bladder is emptied.

13. Every night and morning lie on the back and raise the extended legs high as you can ten to forty times. Walk 3 or 4 miles, saw or split wood, or work in the garden every day. [illegible] rest [illegible]

14. Take a cold bath on rising. not unless [illegible]

15. Take bran bread or biscuit and mineral oil in some form at each meal, and in such a way as to mix with the whole meal; that is not only at the begining and end of the meal but during the meal.

16. Take an enema at night occasionally to make sure that the colon empties well, or take a carmine capsule (p. 518).

17. If necessary, take an enema every night. *Keep clean inside.* If there is pain in bowels, much gas or mucus in stools, make the enema 105 degrees F. to relax the bowel. After evacuation, take a second enema at 80 degrees F. to tone up the bowels. This prevents any injury from the enema and helps to train the colon to more efficient action.

18. *Beware of Drugs.* All laxative medicines, including mineral waters, are highly injurious. They make constipation worse and cause colitis. Agar, bran and mineral or paraffin oil, are the only harmless laxatives. These are accessory foods rather than drugs. They may be used indefinitely without injury.

19. When there is no "call," stimulate the rectum with a small enema at 80 to 70 degrees F. (half pint to pint). In case the enema does not return well, add the juice of a lemon.

20. When the bowels are once regulated, be careful not to interrupt the rhythm. Make no experiments. Keep right on doing the things which succeed, every day and at every meal.

THE ELIMINATION OF DISEASE GERMS FROM THE ALIMENTARY TRACT

The elimination of germs from the alimentary tract is one of the most important things to be accomplished in dealing with most cases of chronic disease. Nature has provided most wonderful means of protecting the body against the invasion of disease-producing germs, but the defence is often broken down, making the employment of special measures necessary.

Stagnation or stasis is one of the conditions which favors bacterial development. It is for this reason that the bacteriology of the alimentary tract relates especially to the six cavities in which fluids or food residues are likely to remain for longer or shorter periods,—the *mouth*, the *stomach*, the *duodenum*, the *gall bladder*. the *cecum*, and the lower *colon*. The methods of dealing with these several parts to rid them of disease-producing bacteria may be briefly summarized as follows:—

The Mouth. — Diseased tonsils must be removed by the surgeon or destroyed by the X-ray. Diseased teeth and gums must be dealt with by the dentist and the mouth put in a thoroughly sanitary condition by the dental hygienist, and kept sanitary by the proper use of the tooth-brush, the orange stick and paper polisher (Hygos) and the use of dry food.

The Stomach. — Normally, the stomach keeps itself clean and aseptic by its acid secretion, hydrochloric acid, which is produced at a strength of one-half of one per cent, equivalent to 1.25 per cent. of the C. P. acid of the pharmacy. When the acid-forming glands lose their function (achylia), the stomach becomes a dangerous breeding place for bacteria which rapidly spread to the intestine and infect connecting organs.

The stomach may be cleansed to a degree by lavage, which is most useful in cases of pronounced "catarrh" of the stomach.

Copious draughts of hot water half an hour before meals is a crude but more or less efficient mode of cleansing the stomach which oftens renders great service in preparing the stomach for the next meal in cases of achylia. The free use of orange juice and other acid fruit juices is another highly useful means of combating the molds and bacteria which thrive in these deteriorated stomachs.

The free use of acidophilus buttermilk is another measure of real value.

Another efficient means is the use of acid protein (Acidone), a dram or two at each meal, the best known substitute for the normal gastric acid, containing about five per cent. of HCl in loose combination with protein.

The employment of chemical antiseptics is useless, even worse than useless because of the extra labor laid upon the liver and kidneys to destroy, distoxicate or eliminate them.

The liberal use of fresh or uncooked foods and adoption of the two-meal a day plan with an interval of seven hours between meals are measures of great service in keeping the stomach and intestine free from bacteria.

The Duodenum. — This expanded, upper part of the small intestine receives the food from the stomach, sterile when the stomach produces a normal gastric juice, but often swarming with bacteria when gastric acid is lacking. Here, also, the bile is poured out. The bile may be a source of grave infection when the gall bladder has become an incubating chamber for typhoid or other disease germs, as is often the case after typhoid fever, in cases of infectious jaundice, and probably in many cases of diabetes. The duodenum is the receptacle of poisons constantly poured into it from the blood, the product of putrefactive processes in the colon.

Infection of the duodenum may also occur by the backing up of infectious material from the colon, a reflux permitted by an incompetent ileocecal valve. The duodenum is one of the great storm centers of the body. Bacteria and their poisons concentrate here and initiate troubles which extend to other parts.

The Gall-bladder. — The liver secretes bile more or less continuously. The gall-bladder stores up the bile and pours it out in small portions to neutralize the acid fluids coming in jets through the pylorus at frequent intervals during gastric digestion. Most of the bile is re-absorbed. It thus becomes concentrated, and when infected, the infection inevitably becomes more and more intense. The infection may extend into the pancreas and cause pancreatitis or diabetes. Ulcer may develop and, in rare cases cancer. Constant exposure of the liver to these concentrated poisons after a time results in sclerosis.

The duodenum and the gall-bladder must be dealt with together. By means of the duodenal tube, the duodenum may be washed out, and even disinfected. The disinfection may be chemical or biologic. The chemical disinfection is simply an imitation of the normal process. A solution of hydrochloric acid (one-fifth of one per cent.) is slowly passed into the duodenum during one hour three times a day. Biologic disinfection is accomplished by passing through the tube a whey culture of *B. acidophilus* and a solution of lactose.

The gall bladder is drained once a day and the bile examined. The draining is repeated daily until the bile is light colored. By this means, the concentrated toxin-laden bile is gotten rid of.

For most thorough-going effects, the duodenal tube will be kept *in situ* for some days, a week if need be, and two or three gallons of water will be passed through daily. The nourishment should exclude protein and fats almost wholly. Milk sugar, malt sugar and fruit juices should constitute the nourishment. Rice gruel, vegetable broths, savora broth and purées of fruits and vegetables may be added after the first three or four days. Most of the large quantity of water introduced will find exit through the kidneys. Some of it may be discharged as watery stools.

By these thorough-going measures, the duodenum and gall-bladder may be ridded of mischief-making bacteria, the bile as well as the flora may be changed and the tissues of the body cleared of tissue wastes and accumulated poisons.

The Cecum. — The head of the colon normally receives the food residues, absorbs two-thirds of its water, and then pushes the mass across the transverse colon and so gives it a good start toward the exit. But the cecum often becomes a widely dilated, adherent, inert pouch, a stagnant reservoir of putrefying food residues, and a source of almost infinite mischief. This condition is very common in cases which have undergone operations for appendicitis, and especially in cases of so-called chronic appendicitis. The ileocecal valve is always incompetent and hence there is no hindrance to the extension of the infection into the small intestine and the development of all the evil results of autointoxication. Headache and neurasthenia in most pronounced forms are frequently associated with this condition.

The pernicious flora of the cecum may be attacked from both directions. By feeding massive doses of lactose or *Acidophilus* culture or of the two combined, the colon bacillus, Welch's bacillus, *B. putrificus* and other putrefactive bacteria, may be driven out. By flushing the colon with copious enemas twice (daily) and the injection of cultures of *B. acidophilus,* the change of flora may be greatly aided.

The Lower Colon and Rectum. — These parts are more easily reached and quite readily yield to the combined attack of Acidophilus-Lactose feeding and colon cleansing followed by freshly prepared cultures of active strains of *B. acidophilus.*

After the use of all these measures, an anti-toxic laxative diet must be scrupulously followed for an indefinite period, meats of all sorts must be vigorously excluded from the dietary, and bran or agar and mineral oil must be freely used to keep the colon free from residues. By these means the body may be freed and kept free from its most deadly and insidious foes, the bacteria which infect the alimentary canal.

DIET IN COLITIS

Colitis is an infection of the colon. The disease owes its origin chiefly to the use of flesh foods, a fact first pointed out by Combe years ago.

A diet which encourages intestinal putrefaction will promote colitis. Hence, meats of all sorts must be discarded. All flesh foods swarm with the bacteria which give rise to colitis.

Chronic colitis may follow an attack of typhoid fever or of paratyphoid, or it may be the result of acute infection, as of botulism and of meat poisoning or an attack of dysentery or diarrhea.

First of all, it is necessary for the intestinal flora to be changed (p. 552), and then kept clean by a laxative diet (p. 580), and, if necessary, by the daily use of the enema. The introduction into the colon of large quantities of cultures of protective ferments such as *B. acidophilus,* is a measure of great value.

The idea that bland foods should be used in these cases is wholly erroneous. Whole grain preparations, such as oatmeal, graham bread, etc., even bran, greens and other fresh vegetables and stewed fruits, may be freely used with advantage.

Meats of all kinds, and in some cases even eggs, must be discarded for they aggravate the disease by encouraging the growth in the colon of the germs to which the disease is due and by increasing their virulence.

Kohnstann rightly insists that meat should be excluded from the diet of constipated persons because it will intensify the autointoxication. In colitis the danger of autointoxication is great because the filtering power of the intestine is greatly diminished. This was demonstrated by Hamburger and Monte, who experimented with anti-toxin. Their observations showed that, although taken into the system very readily when injected under the skin, antitoxins introduced into the rectum are not absorbed to any appreciable amount. This is an excellent demonstration of the filtering power of the normal intestine by which it offers resistance to toxins generated in the alimentary canal. When colitis exists, this filtering power is largely lost. The same has been shown to be the condition after the administration of calomel, saline laxatives and other cathartic or laxative drugs.

According to Fuld, colitis is rare in Russia, a fact which he attributes to the vegetarian diet of the Russian peasant.

In the case of children, milk usually aggravates mucous colitis, and in such cases its use should be stopped at once. In adults, buttermilk or milk porridge may be used when ordinary milk is not tolerated. Malted milk, malted nuts, oatmeal or graham gruel, yellow corn meal gruel, vegetables purées, particularly potato purée and purées of spinach, may be used freely.

DIET IN HYPERCHLORHYDRIA OR HYPERACIDITY

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This, one of the most frequent and important of all functional disorders of the stomach, was the despair of therapeutists until the researches of Pavlov made clear the nature of the difficulty and pointed out rational methods of cure. The pain of hyperhydrochloria usually occurs two or three hours after eating, but may occur during the meal or immediately after. In many cases there is constantly present in the stomach a larger or smaller quantity of intensely acid secretion. The gastric crises which occur in locomotor ataxia and certain forms of migrain and in connection with certain other maladies are usually associated with hyperhydrochloria.

No better illustration could be found of intelligent defensive effort on the part of the body than may be noted in connection with this disease. There are at least three distinct defensive processes: (1) The increase of saliva, the purpose of which is to neutralize the bile by its alkalinity. In some instances an exceedingly profuse flow of saliva is observed. (2) A reflux of bile into the stomach. This is not an infrequent circumstance in connection with hyperhydrochloria and is distinctly palliative, since the bile neutralizes the acidity of the gastric juice by its alkalinity and also precipitates the pepsin present. (3) Loeb has called attention to the fact that in hyperhydrochloria the ammonia of the urine is very considerably diminished. This accounts for the large amount of neutral chlorin which is found in the stomach in these cases. Hayem and Winter long ago called attention to the fact that in hyperhydrochloria the acid chlorine (coefficient "a") is often much below normal, sometimes being reduced to an extraordinarily low figure. This is due to the fact that a large amount of the chlorin has been neutralized by combination with ammonia which has been diverted from the usual channels of discharge to be used for this defensive purpose. The actual amount of ammonia is increased because of the intense intestinal putrefaction always present, a fact which has been observed by many authors.

Fuld has called attention to the fact that constipation is both a result and a cause of hyperchlorhydria, and Ebstein has shown that hyperchlorhydria is improved by relief from constipation.

Professor Taylor of Philadelphia mentions the fact that certain experiments have shown that absorption of poisons from the colon may excite an excessive production of gastric acid.

Roger, who made an elaborate study of the toxins produced in the alimentary canal under various conditions, demonstrated that one of the functions of the stomach is to excrete poisons from the blood. He holds that these poisons may be derived from intestinal putrefaction. One of the functions of the stomach seems to be to eliminate the poisons absorbed from the intestines. Roger found the toxicity of the contents of the stomach of the vegetable feeding rabbit to be only one-third as great as that of a dog fed on meat.

It appears to the writer that the evidence is very strong that the intestinal toxins excreted by the stomach are a leading factor in the production of hyperhydrochloria, and that the excessive secretion of hydrochloric acid is a part of the defensive effort of the body in combating these toxins. It has been shown that the gastric juice destroys a considerable number of the enterotoxins, and it may be for this purpose primarily that the excess of acid is poured into the stomach.

In the treatment of hyperhydrochloria it is evident, then, that the first and most essential thing to be done is to combat intestinal autointoxication. The writer's experience in the practical application of this theory to the treatment of cases of hyperhydrochloria has been most satisfactory. But there are many other causes of hyperacidity which must be taken into consideration.

While it is probable that the quality of the secretion produced by the acid-forming glands of the stomach never varies, there is no doubt that the amount of acid produced, or at least that the amount of acid found in the stomach, varies considerably. The normal gastric fluid found in the stomach after a test meal contains about one-fifth of one per cent of hydrochloric acid. The amount of free or uncombined acid is about one-fourth or one-half this proportion or one-twentieth to one-tenth of one per cent.

The unpleasant symptoms attributed to hyperacidity or hyperhydrochloria are due to the presence of an excess of free acid; that is, acid which has not entered into combination with the protein of the food in the process of digestion. It may happen, then, that hyperacidity is due either to an excessive production of acid in the stomach or to failure of the acid produced to enter into combination, thus becoming an irritant.

The amount of acid formed by the stomach in the digestion of a meal depends primarily upon the character of the food. All physiologists confirm the observation of Pavlov that animal foodstuffs produce a higher degree of acidity than do vegetable foods, the average acidity for beef being 120, for eggs 80, and vegetables 70. Milk produces greater acidity than do eggs. Bread and cereals produce the lowest degree of acidity. The degree of acidity produced by animal foodstuffs is equal to that which is universally regarded as pathological and indicative of disease. From this fact the inference may be clearly drawn that the habitual use of meats must tend to produce a diseased condition of the stomach. Low acidity may be due to severe anemia, to gastritis, to a regurgitation of alkaline secretions from the intestine, or may be of purely nervous origin.

The causes which may give rise to hyperacidity are numerous. The following may be mentioned as those which are best known:

Meats. Pavlov showed by experiments upon dogs that meats, that is, animal flesh, fish, fowl, and shellfish, as well as ordinary meats, when taken into the stomach cause the production of highly acid gastric juice. The normal acid produced by dogs is for this reason much more acid than that produced by human beings. It is interesting to note that when a man eats the diet to which a dog's stomach is naturally adapted rather than his own proper bill of fare, his gastric glands are stimulated to meet the emergency by producing a gastric juice like that ordinarily produced by the dog. Protein requires a highly acid gastric juice for its digestion. This is doubtless due to the fact that protein absorbs hydrochloric acid, entering into combination with it as does soda and other alkalies. For this reason persons suffering from hyperacidity are usually made very comfortable by a meal consisting largely of meat. This fact is deceptive and led to the practice of feeding patients suffering from hyperacidity on a meat diet. Prior to the publication of Pavlov's epoch-making book on the digestive glands, scraped beef, raw beef and meat in other forms as an exclusive diet, so-called Salisbury steaks, was the universal remedy for hyperacidity. A meat diet gives temporary comfort in these cases by neutralizing the hydrochloric acid but at the same time stimulates the gastric glands more and more to the production of an increased quantity of acid.

Hyperacidity is a disease from which great meat eaters are especially likely to suffer. There are physicians who, not aware of Pavlov's work, prescribe a meat diet in this disease and with more or less temporary success, but their patients usually fall into the hands of surgeons later for operation for gastric or duodenal ulcer.

Meat Extracts. Pavlov's observations also demonstrated the fact that the extractives of meat stimulate the acid-forming glands of the stomach to a very high degree. Hence bouillon and animal broths of all sorts must be discarded in the treatment of hyperacidity.

Milk. Next to meat, milk, including cheese and other dairy products, stimulates the acid-forming glands of the stomach, this action being due to the large amount of protein present in milk in the form of casein.

Cane sugar excites the acid-forming glands to a very high degree. Malt sugar, milk sugar, and honey, a mixture of levulose and dextrose, differ from cane sugar in this respect and may usually be eaten in moderate quantities, often quite freely, in cases of hyperacidity.

Dextrin. Pavlov showed that crude dextrin is a powerful excitant of the gastric glands. This fact affords an explanation of the frequent occurrence of heartburn as the result of the free use of oatmeal in the form of porridge and other cereals eaten in the pasty condition resulting from long boiling. New bread is objectionable for the same reason, the central or soft portion of the loaf being often swallowed in doughy lumps which reach the stomach without being acted upon by the saliva. It has recently been shown by Marshall that undigested starch in large amount in the stomach absorbs the pepsin of the gastric juice and thus prevents the acid from entering into combination with the protein of the food and so increasing the percentage of free hydrochloric acid.

Highly flavored foods create an excess of highly acid appetite juice by over-stimulation of the gustatory nerves.

Hot foods over-excite the gastric glands, congest the stomach, and when excessively hot may even give rise to injuries of the gastric mucous membrane which may ultimately cause ulcer, and according to Dr. William Mayo, may become a cause of cancer. While over-production of gastric acid under the influence of heat has not been demonstrated by laboratory experiment, there are clinical reasons for believing that excessively hot food and drinks do produce this effect.

Ices, when taken with the food, interrupt the process of digestion and delay the exit of the food from the stomach, thus giving rise to the production of an excess of free acid.

Water. Pavlov showed that when water is taken in more than very small quantities, gastric acid is increased. Hence free water drinking at meals must be forbidden for persons suffering from hyperacidity.

Acids of all sorts increase the production of gastric acid. Mineral acids and acid protein, that is, protein with which acid has been combined, produce this effect in a very high degree. Pavlov recommended the administration of gastric juice obtained from the stomachs of dogs as a means of stimulating the stomach to produce an increased amount of acid in cases of hypohydrochloria or deficient formation of acid. This method has never become popular.

A preparation of acid protein known as Acidone contains 5 per cent of hydrochloric acid, equivalent to 12½ per cent of the C. P. hydrochloric acid of the pharmacy. A quarter of an ounce of this preparation is equivalent to 15 minims (30 drops), of C. P. hydrochloric acid or half an ounce of the dilute hydrochloric acid of the pharmacy. Acidone or its equivalent should be constantly used by persons suffering from extreme hypoacidity or achylia.

Fruit Acids. The citric acid, malic acid, and tartaric acid found in fruits are much less stimulating to the gastric glands than is hydrochloric acid, but are more or less stimulating and in most cases of hyperacidity must be on this account forbidden until the patient's condition has been improved. It should be noted, however, that in many cases the intolerance of acid fruit is due, not to an excess of acid, but to a hypersensitiveness due to a disordered condition of the gastric nerves rather than to over-stimulation of the gastric glands. The same is doubtless also true as regards the acid of the gastric juice. The distressing symptoms of which patients complain may be due not to an excess of acid but hypersensitiveness resulting from disease.

Tomatoes, which contain citric acid, and rhubarb, a poisonous plant which contains oxalic acid, are objectionable on the same grounds as acid fruits. As patients recover, tomatoes are better tolerated, especially moderately acid varieties, but rhubarb should be definitely discarded as unwholesome and poisonous, irrespective of its injurious effect upon the stomach.

Butyric acid, as found in "strong" butter and rancid oils, is highly irritating to the acid-forming glands of the stomach.

Tannic acid, found in large amount in tea, is objectionable on the same ground; it also precipitates pepsin leaving the gastric acid free and so irritating.

Vinegar, because of the acetic acid present, is always unwholesome and is particularly injurious in cases of hyperacidity. It interferes with starch digestion.

Buttermilk contains lactic acid and so is objectionable in severe cases of hyperacidity, though ordinarily well tolerated.

Alcohol. It has long been known that alcohol excites the activity of the gastric glands. It has long been used for this purpose by physiologists in experiments upon the stomach. The observations made by Chittenden and Sir Wm. Roberts show that while alcohol stimulates the stomach to make an increased amount of gastric juice, including gastric acid, it destroys the activity of the juice by precipitating the pepsin. This action of alcohol, by preventing the combination of the free acid with the protein of the food, renders it a direct cause of hyperacidity and necessitates its total prohibition in any form in persons suffering from hyperacidity. So-called light wines and beer are objectionable just in proportion to the amount of alcohol which they contain.

Tobacco. It is well known that smoking often gives rise to the excessive production of acid in the stomach. It has been shown experimentally by Gy and others, that digestion is hindered by smoking.

Caffein, the active constituent of tea and coffee, directly excites the acid-forming glands of the stomach. The theobromin of cocoa produces the same effect. Tea, coffee, cocoa, and maté, or Paraguay tea, are objectionable for the same reason. Kaffee Hag, though said to be free from caffein, is nevertheless objectionable because of the tannic acid and phenolic bodies which it contains, which excite the acid-forming glands besides being otherwise injurious. Most cereal coffees are harmful for the same reason.

Condiments, under which head is included mustard, pepper, cayenne, ginger, cloves, spices, horse-radish, Worcestershire sauce, and all similar substances, excite the acid-secreting glands of the stomach and thus produce hyperacidity. It is true that after being used for some time, the gastric secretion is lessened, but this only occurs when the glands have been destroyed by degeneration, the result of chronic irritation and overwork.

Common salt induces hyperacidity when taken in considerable amount though interfering with digestion (Debove), by furnishing an excess of the material from which the gastric acid is made. In hyperacidity the use of salt should be at least restricted to very minute quantities.

Carbonated water is objectionable in hyperacidity because the gastric glands are stimulated by carbonic acid.

Errors in the manner of eating are without doubt in a large measure responsible for hyperacidity in many cases.

Hurried eating permits the food to enter the stomach in large masses which, being retained for a long time, result in the over-accumulation of acid in the stomach.

Over-eating, by over-stimulation of the gastric glands, likewise produces an excess of acid.

Too frequent eating produces hyperacidity by giving the stomach no opportunity for rest. When food is taken into the stomach the gastric mucous membrane becomes congested and the glands are filled with blood. After the completion of the digestion of a meal, the stomach should have an opportunity for rest and complete clearance before the next meal is taken. When a meal is taken before the stomach is empty, the stomach has no opportunity for rest or clearance, and hyperacidity is one of the resulting ill effects.

Eating between meals is objectionable for the same reason as too frequent meals. It is rare that more than three full meals a day can be taken without injury. The only exceptions are cases in which the amount of food taken is small and the kind of food such as will leave the stomach in an hour or two. In such cases, four meals or even more may be necessary to supply the body with the proper amount of nutriment. If food is to be taken more than three times a day, it is highly important that close attention should be given to the kind of food taken and the exact spacing of the meals so that they shall not overlap. The common practice of recommending patients to take milk or other food between meals, while at meal times taking ordinary foods which do not usually leave the stomach within less than five or six hours, is strongly to be condemned.

Excessive chewing must be mentioned as another cause of hyperacidity. Chewing, as shown by Pavlov, produces appetite juice. The stomachs of persons suffering from hyperacidity usually contain constantly an excess of acid. Consequently, in such persons it is not necessary that the stomach should be prepared for a new intake of food by prolonged chewing, as urged by Mr. Fletcher; in fact, long chewing becomes in hyperacidity a means of aggravation of the existing morbid conditions. On this account persons suffering from hyperacidity to an extreme degree should take all their foods in the form of purées or porridges. The food should be swallowed with very little chewing. Thin soups should be avoided because they contain an excessive amount of water which stimulates acid formation (Pavlov).

Constipation. It is a quite common observation that chronic constipation is an almost universal accompaniment of hyperhydrochloria. An explanation is to be found in the fact that in constipation the long retention of the foodstuffs in the colon afford good opportunity for a considerable amount of putrefaction in which there is a digestion of proteins by bacteria and the production of poisonous peptones. Pavlov showed that peptone is one of the most powerful of all stimulants of the gastric glands. This is shown to be true even when the peptone is introduced per rectum through the absorption of the peptone by the mucous membrane of the colon and its excretion into the stomach. The same occurs in cases of colitis in which the filtering power of the mucous membrane is largely lost. Absorption of the poisonous peptones and other products of putrefaction takes place in still larger amounts in cases of incompetency of the ileocecal valve, in which there is a backing up of putrid materials from the colon into the small intestine where absorption takes place with great facility. This condition is very common in cases of hyperhydrochloria.

Mental and nervous influence may give rise to hyperacidity through the gastric nerves. That worry and anxiety cause this condition is well known.

It is also well known that the reflex influence of a *diseased gall-bladder or duodenal ulcer* may give rise to a very high degree of hyperacidity which disappears when the exciting cause is removed.

Influences Which Lessen the Secretion of Hydrochloric Acid.

Pavlov showed that fats of all sorts, and particularly olive oil, have a powerful influence to check the formation of acid by the gastric glands. This is only true, however, when the fats are perfectly fresh, that is, free from butyric acid, the presence of which is disclosed by a strong or rancid flavor, and which excites the gastric glands.

Pavlov also showed that cereals give rise to a gastric secretion which is low in acid but high in digestive power, that is, rich in pepsin. The observations of Pavlov have been confirmed by the experimental work of Rehfuss of the Pennsylvania University and many others.

By taking the food in the form of purée, so that no chewing is required in passing it through the mouth quickly, the gustatory nerves are only slightly stimulated and less appetite juice will be produced.

The observations of Hemmeter showed in experiments upon animals that the withdrawal of salt from the food may cause the total disappearance of acid from the gastric secretion. It is known that the gastric acid is lessened in cases of fever. It has been determined that in fever there is a marked tendency to the retention of chlorid of sodium in the tissues. It is quite possible that a positive relation may exist between these two facts. It is certain that when it is desirable to lessen the secretion of hydrochloric acid by the stomach the intake of chlorid of sodium should be reduced to the lowest limit or at least, common salt should be taken only in very small amounts.

In the majority of cases of hyperacidity complete relief may be obtained by the following simple measures which have been used with success in the treatment of many hundreds of cases:

1. The discarding of meats, condiments, and all other things which are known to excite the secretion of gastric acid. (See above.)

2. All food should be taken in the form of purée or porridge and should be chewed very little. Dextrinized cereals should be the principal foods.

3. Milk should be avoided but cream may be taken in moderation. In some cases butter is preferable, and in general, butter should be freely used.

4. No salt should be added to the food and the amount used in seasoning the food should be greatly reduced. By gradual diminution its absence will not be missed. The butter used should be without salt. If such butter is not obtainable, the butter should be washed so as to remove the salt present.

5. The bowels should be made to move freely three or four times a day by the use of a laxative diet (p. 580), a quarter ounce of bran or a third of an ounce of agar at *every meal,* and half an ounce of paraffin oil in some form taken before and after every meal. An enema should be taken at bed time two or three times a week. If considerable fecal matter is shown by the enema to be present, the enema should be used every night until the colon has been trained to more efficient action. There is no ground for the fear that bran will aggravate the difficulty by irritating the stomach. It cannot be too often repeated that bran does not irritate; it titillates.

6. Measures should be adopted to change the intestinal flora (see p. 552).

7. The following foods should be absolutely and permanently discarded: Cane sugar, tea and coffee, alcoholic drinks of

all sorts, carbonated waters, condiments of all sorts, meats of every description, also meat broths and extracts, much salt and salty foods, vinegar and pickles; and water-drinking at meals must be avoided.

8. Olive oil must be used freely. The quantity should not be less than half an ounce at each meal and twice the amount is required in some cases. The amount should be increased to the point of tolerance if the acidity is not relieved without. It should be remembered, however, that gastric pain, which is usually attributed to hyperacidity, may in some cases be due to disease of the gall-bladder, in which case the use of olive oil may give only slight relief, or even none at all. If the oil "repeats," it should be taken in teaspoonful doses at first, the quantity being gradually increased.

It is also to be borne in mind that pain accompanying hyperacidity is not always due to an excess of acid but is often due to an abnormal sensitiveness of the gastric mucous membrane, and this condition may exist even when there is no excess of acid, or when acid is absent.

In all cases in which relief is not obtained by the measures herein suggested for hyperhydrochloria, tube feeding, as recommended for duodenal ulcer, should be resorted to. In these obstinate cases, it is quite probably that gastric or duodenal ulcer may exist, either with or without disease of the gall-bladder. Careful investigation should be made to determine whether or not disease of the gallbladder is present, by X-ray examination and also by drainage of the gallbladder by the non-surgical method of Metzger and careful bacteriological examination of the bile.

In extreme cases, it is sometimes necessary to adhere closely for a time to the diet recommended for gastric and duodenal ulcer.

GASTRIC AND DUODENAL ULCER—PEPTIC ULCER

(Page 859)

The cause of gastric and duodenal ulcers is still a subject of discussion. The existence of the so-called "peptic ulcer" has recently been called in question. To the writer, it seems most reasonable to regard the ulcer as due to infection resulting from loss of general or local resistance, or both. Recent observations showing the probable relation between pyorrhea and a dietary lacking in vitamins, suggest the possibility that gastric and duodenal ulcers may be likewise due to focal infection in the mouth.

Of all dietetic problems, the feeding of cases of gastric and duodenal ulcer is one of the most important, most interesting and most difficult of solution. It is now generally recognized that, aside from surgical procedures, dietetic measures are practically the only ones which afford substantial relief in these cases. Nearly all cases may be more or less relieved by proper dietetic treatment, and in by far the greater majority of cases, at least nine out of ten of the milder class of cases of duodenal ulcer, may be temporarily, if not permanently, relieved.

There is in these cases an inveterate tendency to relapse. This tendency is so marked that a well-known surgeon being asked the question, "When should surgery be restorted to in cases of duodenal ulcer," replied, "When they have been cured nine times." It is probable that in a large proportion of cases relapse might be prevented by very careful adherence to a specific dietary. Unfortunately, however, the average ulcer patient does not consider himself cured of his ulcer unless able to return to his ordinary diet, which is invariably the dietary well calculated to develop ulcer and very likely to lead to a relapse. Relapse is in such cases almost inevitable for the reason that the fact of the first occurrence of the ulcer is evidence that the resistance of the body to the causes which produce ulcer of the stomach and duodenum has so broken down that the development of ulcer can in the future be prevented only by careful avoidance of all the causes known to be provocative of these conditions, particularly those foodstuffs which unduly tax the energies of the stomach and weaken its defense by prolonging the digestive period with over-stimulation of the gastric glands.

The first symptoms of the disease, cancer of the stomach, which carried off Napoleon, made their appearance some seven years before, after he had eaten a shoulder of mutton cooked with garlic. He doubtless had at that time a gastric ulcer, which was a prominent factor in his downfall, and on which later developed the cancer which caused his death.

Every case of gastric and duodenal ulcer should be studied by an X-ray expert to determine, if possible, the location of the ulcer and whether or not it is a so-called "penetrating ulcer." This examination is also important for the reason that it often throws light upon the question of the presence of cancer, always a possibility in these cases, especially when the seat of disease is the stomach. When cancer is present, an operation, if the case is operable, is the only course which offers any hope for the patient.

An operation is also imperatively indicated when the ulcer involves the pylorus for the reason that an ulcer in this region is certain sooner or later to cause delay in the emptying of the stomach, because of mechanical obstruction at the outlet. When marked obstruction is actually present, as shown by long retention of the food in the stomach, operation is positively indicated. Very profuse hemorrhage or repeated hemorrhages, whether from the stomach or duodenum, as shown either by the vomiting of blood or by bloody stools, is an urgent indication for operation.

According to Charles H. Mayo, an investigation made in the Mayo Clinic of 438 cases of duodenal ulcer which had been operated on, showed that, from the standpoint of the patient, 70 per cent. considered themselves well following gastro-enterostomy, 25 per cent. were improved and 3 per cent. unimproved. The mortality was about 1.6 per cent.

An analysis of 500 cases of duodenal ulcer treated at the Battle Creek Sanitarium, made by Dr. E. L. Eggleston, (*Jour. of A. M. A.*), showed a cure with no relapse within three years in seventy per cent. of all cases treated. A course of treatment extending over not less than five weeks was found necessary for a cure and it was also found to be essential that the patient should follow permanently a carefully regulated regimen.

If the X-ray examination shows that the ulcer is penetrating in character, that is, if it has formed a deep pocket through more or less destruction of the muscular walls of the stomach, an operation is clearly indicated for the reason that these ulcers are seldom, if ever, permanently cured by other than operative measures, and are dangerous because likely to penetrate into the peritoneal cavity.

Cases of gastric and duodenal ulcer usually make rapid improvement when the stomach can be permitted to rest from digestive activity. A most efficient plan of treatment, introduced in this country by the elder Flint, under whom the writer received an important part of his medical training, was starvation. More than 40 years ago the writer treated cases of this sort with success by a fast of one to two weeks. In one case thus treated more than 30 years ago, in which the patient was nearly exsanguinated by loss of blood, the patient remained in good health for more than 10 years and then suffered a relapse which was cured in the same way, after which the patient remained in good health for a number of years before she was lost sight of.

Complete fasting is, however, no longer necessary since the duodenal feeding tube has been devised. By duodenal feeding, the stomach can be given rest while the body is being supplied with needed nourishment. The duodenal feeding tube is so small and flexible that it is easily swallowed, and after the first few hours it gives practically no inconvenience, so that it may be retained in place for several days, even two or three weeks, without giving rise to either serious discomfort or injury of any sort.

Thus tube feeding is beneficial in cases of gastric and duodenal ulcer, not only through giving the stomach rest but because of the reflux of bile which allays irritation, by neutralizing the acid gastric contents. The bile also precipitates the pepsin and so stops its digestive action on the ulcer. The tube thus secures results similar to those of the operation of gastroenterostomy and so may sometimes take its place.

Some excellent gastro-enterologists question the value of the duodenal feeding tube on the ground that it produces mechanical irritation. It is entirely possible that the brilliant success which has followed the use of the tube would have been equally or even more successful if suitable oral feeding had been employed. The writer feels certain that any case of gastric or duodenal ulcer which does not require surgery can be cured by gastric rest and carefully graduated feeding.

It is now generally conceded by experienced practitioners that most well developed gastric ulcers require surgical attention for radical relief.

It is a common practice to administer through the tube six to nine ounces of food every two hours. A better practice is to give a small amount at hourly intervals. The food should be very slowly introduced. It should be remembered that the duodenum normally receives food very slowly, during a period of about four hours. Three times a minute the stomach ejects about half a teaspoonful of liquid through the pylorus into the duodenum, or one ounce every five minutes. When large quantities are forced into the duodenum at one time, the result is a reflux into the stomach. This, of course, in part defeats the purpose of this special mode of feeding, which is to give the stomach rest, so that the diseased surfaces may not be subjected to the irritating effect of contact with food.

The ideal plan of feeding is to introduce the food at the rate of about two ounces every fifteen minutes, omitting the feeding the last quarter of each hour. Continue this for four hours, then allow a rest for one hour. A good schedule is to start the feeding at seven o'clock in the morning. Continue until eleven o'clock. Rest for one hour; resume at twelve o'clock; continue until four. Rest again from four to five. Begin feeding again at five o'clock and continue till eight or nine o'clock.

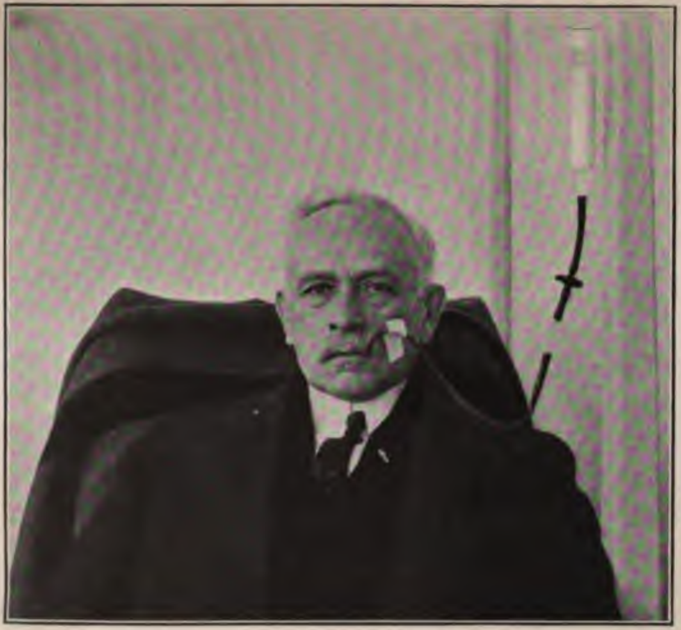
The food having an energy value of thirty calories to the ounce, the hourly intake would be 180 calories, and the amount for each feeding period 720 calories. The total intake for the day will depend upon the number of hours during which the feeding is continued. Eight hours will give 1440 calories; ten hours, 1800 calories; twelve hours, 2160 calories.

The food should never be forced into the duodenum by means of a syringe. Instead, it should be permitted to run in slowly by gravity, as shown in the accompanying cut. The patient soon learns to regulate the inflow in such a way as to produce no discomfort or other inconvenience.

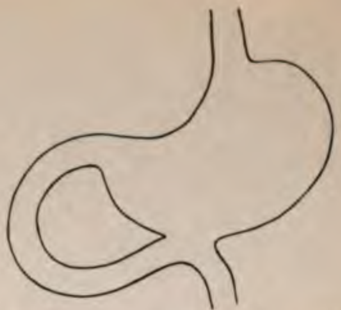
The amount of liquid introduced daily should be two or three quarts.

The patient should not only remain quiet but should remain as much as possible in the open air. The cure is facilitated by a fomentation over the upper abdomen, repeated two or three times a day. In the intervals between the fomentations the heating compress should be applied. The cold mitten friction or cold towel rub should be employed twice a day, and light massage of the arms, legs, back, and lower abdomen should be given daily. Sun baths and arc light baths are also exceedingly helpful.

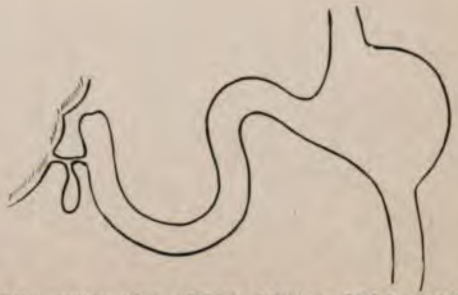
Care should be taken to empty the colon at least twice a day by a thorough enema, which should consist of three or four pints of water at 105° F., followed, after evacuation of the bowels, by two pints at 80° F. It is well, also, to administer an ounce of paraffin three times daily. The patient may take sips of water through the mouth, but large quantities of water should not be taken for the reason that water in quantity stimulates the pro-



DUODENAL FEEDING



THE STOMACH AFTER GASTROENTEROSTOMY



THE STOMACH AFTER POLYA OPERATION FOR CANCER

duction of gastric acid, as shown by Pavlov. Two or three pints of water should be introduced into the colon daily to insure an adequate water intake.

As regards gastric ulcer, it must be admitted that there is so strong a tendency to relapse that serious cases usually fall into the hands of the surgeon at last. The danger of fatal hemorrhage or of the later development of cancer is sufficiently great to justify operation in every severe case of ulceration of the stomach or duodenum.

There is little danger of cancer from duodenal ulcer, and the results of treatment are usually better than in cases of gastric ulcer.

Every patient who has once suffered from gastric or duodenal ulcer and who has been relieved by treatment or by operation must faithfully adhere to a careful, antitoxic regimen, avoiding meats, tea and coffee, much salt, condiments and other things that excite the gastric glands (p. 568).

The foods best adapted to duodenal feeding are gruels, re-enforced with malt sugar or milk sugar and egg yolks or purées of spinach. Milk or buttermilk with yolks of eggs and an addition of cereals make an excellent combination. The egg yolk should be cooked until thickened, then rubbed smooth with a little milk and more milk added until a uniform mixture is obtained. Raw white of egg is indigestible, encourages intestinal putrefaction, and should never be used .

Sugar Formula. In 15 ounces of hot water dissolve 9 ounces of milk sugar. When completely dissolved, add water sufficient to make 20 ounces. Each ounce of the mixture will represent 50 calories of carbohydrate. The mixture should be boiled to sterilize it and then kept on ice to prevent fermentation. This sugar solution is to be used as an addition to other food mixtures and also to water and fruit juices. Twenty ounces is the amount to be used daily. Milk sugar is not only a food, but aids greatly by encouraging the establishment of a normal intestinal flora.

Dextrin Solution. In many cases dextrin or lacto-dextrin is found superior to milk sugar (lactose). It is equally valuable as an aid to growth of the *B. acidophilus* in the colon (change of flora) and does not produce nausea as lactose does in some cases. It should be used in the same quantities.

As combinations suited for tube feeding may be mentioned egg yolks and buttermilk, egg yolks with fruit juice, sugar water, or gruels prepared from rice, oatmeal, millet, soy flour, toasted rice gruel, gruel prepared from brown rice. Most excellent are malted gruel, potato gruel, banana flour gruel, purée of spinach, bean broth, orange juice, tomato juice, yogurt buttermilk prepared with the *B. acidophilus* ferment and whey cultures of *B. acidophilus,* especially *Acidophilus-Lactose.*

It is important to note in duodenal feeding, as in all other special dietaries, that the necessity for a daily adequate supply of vitamins, lime, and iron must not be overlooked. These elements are equally as important as are fats, carbohydrates, and proteins.

Vitamins are found in rich abundance in greens, orange juice, tomato juice, milk and yolk of eggs. In many foodstuffs, vitamins are deficient, especially in cereals. Butter or cream is an essential ingredient of duodenal feeding mixtures because of the important fat soluble vitamin which it supplies. Careful balancing of the diet is as necessary in duodenal feeding as in ordinary feeding. Yeast extract (Savita, Marmite) is very useful as a source of iron and vitamins. Malted Nuts is rich in iron and so preferable to milk or Malted Milk.

Each of the following formulas consists of 9 ozs. and is sufficient for one hour's feedings.

Malted nuts	1 oz.
Curdled egg yolk	one
Orange or tomato juice	2 oz.
Water	6 oz.

Protein, 40; fat, 120; carbohydrate, 70; total calories, 230.

20% gluten meal	1 oz.
Cream	3 oz.
Tomato juice	2 oz.
Savita (yeast extract)	¼ teaspoonful
Water	3 oz.

Protein, 30; fat, 150; carbohydrate, 150; total calories, 290.

Rice gruel	6 oz.
Cream	2 oz.
Egg yolk	½ oz.
Savita	1 teaspoonful

Protein, 21; fat, 145; carbohydrate, 45; total calories, 211.

Potato purée	4 oz.
Bean broth	2 oz.
Cream	1 oz.
Savita	¼ teaspoonful
Water	2 oz.

Protein, 24; fat, 88; carbohydrate, 112; total calories, 224.

It is not wise to use the same formula continuously. The formula should be changed each day, or two or three of the above formulas may be used in alteration on the same day.

The Gluten-Feeding Method.

It is well known that proteins enter into combination with the hydrochloric acid of the gastric juice. This combined acid is far less irritating than free acid. This fact is the basis of the gluten-feeding method. Forty per cent. cooked gluten meal is used for the purpose in the form of gruel with the addition of cream, butter or olive oil. The butter must be perfectly sweet. The following is a feeding schedule which will be found highly satisfactory:

First Day. Feeding formula: gruel prepared with 40 per cent. gluten meal. Teaspoonful of Savita. One ounce of gluten meal, eight ounces of water. Either no salt or a very little. Two ounces of cream. Water to make eight ounces. Calories, 200. The mixture supplies 25 calories per ounce.

Give two tablespoonfuls (one ounce) every hour from 7 A. M. to 9 P. M., 375 calorie.s

Second Day. Feeding formula: the same as the first day.

Feed one and a half ounces every hour from 7 A. M. to 9 P. M., 560 calories.

Third Day. Feeding formula: two ounces 40 per cent. gluten; three ounces cream; one and a half ounces milk sugar or lacto-dextrine. Water to make one pint. Food value 40 calories per ounce.

Feed one and a half ounces every hour from 7 A. M. to 9 P. M. Total, 900 calories.

Fourth Day. Feeding formula: the same as the third day with the addition of one egg yolk at the 8, 10, 12 A. M. and 2, 4 and 6 P. M. feedings. Total calories, 1,272.

Fifth Day. Feeding formula: may be exactly the same as the fourth day with the addition of another ounce of milk sugar to the pint. Total calories, 1,422.

Sixth to Ninth Day. Feeding formula: 40 per cent, gluten mush, cream, rice purée, olive oil, curdled egg, feeding every two hours, 7, 9, 11 A. M., 1, 3, 5, 7 P. M. Total calories, 2,100.

Tenth to Fifteenth Day. Feeding formula: the diet consists of gluten mush, peas purée, cottage cheese, boiled rice, rice flakes, granola mush, cream, graham toast, potato purée, brose with butter, purées of lentils or spinach and other fresh vegetables, Malted Nuts, olive oil, butter. Total calories, 2,200 to 2,500.

After a course of treatment for gastric or duodenal ulcer, the diet for hyperchlorhydria should be adopted permanently.

DIET FOR HYPOCHLORHYDRIA AND ACHYLIA

(Pages 861, 862)

A deficiency or total absence of hydrochloric acid is encountered in about half the cases of gastric disorder. The overwork of the acid-forming glands which causes hyperchlorhydria naturally results in the premature wearing out of the glands so that hypochlorhydria is a natural sequence of hyperchlorhydria. In the advanced stages of chronic gastritis and in advanced malignant disease either of the stomach or of any other part of the body, hydrochloric acid is likely to be absent. Pepsin may be either absent or present. It is important to determine whether or not the pepsin-forming glands have undergone degeneration. This may be ascertained by a simple test. If the digestive activity of the stomach fluid obtained after a test meal is restored by the addition of hydrochloric acid, this means that pepsin is still formed. It is possible that pepsin may be absent from the gastric juice although the glands which secrete pepsin may not be degenerated, lacking only the necessary stimulus to bring them into activity. In such cases the administration of acid protein (Acidone), will stimulate the activity of the glands (see p. 642).

Normally about one-fourth of the hydrochloric acid secreted by the stomach is absorbed or neutralized by mucus. In cases of gastric catarrh, the enormous excess of mucus may neutralize nearly the entire gastric secretion. In such cases, acid protein should be freely used if well tolerated.

The functions of hydrochloric acid in the process of digestion are so numerous and varied that the loss of this element of the gastric juice is necessarily attended by more or less grave consequences. This will readily appear when we recall that the hydrochloric acid of the gastric juice not only aids the digestion of protein but closes the upper or cardiac orifice of the stomach, disinfects the food, activates pepsin, opens the pylorus, closes the pylorus, stimulates the flow of the bile and of the pancreatic juice, activates the pancreatic juice and hence is highly essential to good digestion. One of the worst of the consequences of the lack of hydrochloric acid is infection of the stomach and intestine through the loss of the disinfecting function of the gastric acid. Hence it is that bacteriological examination of the stools reveals the presence of vast numbers of pernicious bacteria, in consequence of which the stools are very foul and in many cases colitis is present. The ileocecal valve is generally incompetent, gastric catarrh and catarrh of the gall-bladder are found in a very large proportion of cases and the occurrence of gall-stones is frequent.

The diet in hypochlorhydria is less restricted than in almost any other condition except that of perfect health. Acid fruits should be used freely. To a slight extent the acids of fruits are a substitute for gastric acid and aid digestion when pepsin is present. The intake of fat should be small. An ounce a day is sufficient to meet all physiologic needs. Large quantities of fat are objectionable because their presence in the stomach, in some way not understood, hinders the secretion of hydrochloric acid when this function is not wholly lost. Fat also delays the passage of food from the stomach. This action appears to be entirely independent of the secretion of acid by the stomach. When fat is taken in large amount, it is likely to be retained in the stomach a long time, and in the absence of gastric acid, fermentative and putrefactive changes are likely to take place, with the result that the fat becomes rancid and the patient may suffer from heartburn and great distress with vomiting of rancid gastric contents.

Persons suffering from achylia and with very marked hypochlorhydria should make daily use of acid protein. Acid protein (Acidone) is prepared by adding to pure vegetable protein about 15 per cent. of C. P. hydrochloric acid. This preparation may be used freely and without inconvenience by mixing it with other foodstuffs, such as thick soup, porridge, mashed potato or other vegetable purées. It not only aids the stomach in performing its digestive work, but stimulates the gastric glands to produce their normal secretion. Hydrochloric acid, as ordinarily used, accomplishes little because of the extreme smallness of the dose compared with the amount required to do actual digestive work. As ordinarily administered, the amount of acid given is less than one-twentieth the amount normally produced for the digestion of a single meal. The amount is too small to render appreciable service.

It is an error to suppose that flesh foods are to be recommended when hydrochloric acid is deficient or absent, a conclusion which might be drawn from the fact that meats of all sorts are forbidden when acids are present in excess. The condition of the gastric juice in hypochlorhydria, it is true, is the very opposite of the condition found in hyperchlorhydria, but the cause is essentially the same. In hyperchlorhydria the glands have been over-stimulated by meat eating and other excitants of the gastric secretion. The glands are over-worked. Achylia is a condition in which the glands have ceased to secrete hydrochloric acid because they are worn out with over-work. Since a highly acid gastric juice is necessary for the disinfection as well as the digestion of meats of all sorts, it is evident that when this condition is present, meats should not be eaten, for in the condition in which they are eaten practically all meats are greatly in need of disinfection before being accorded a place upon the bill of fare, or at least before or after entering the stomach. Ordinary cooking does not destroy the vast numbers of germs present.

Another fact of importance in relation to this condition is the recently discovered association of gall-bladder disease with diminished gastric acid secretion. Hohlweg found gall-bladder disease in 71 to 84 per cent of all cases of hypochlorhydria. Hypo-acidity was also found by Olly in nearly all cases of gall-stone disease.

It is known that gall-stones are due to infection of the gall-bladder. Diminished gastric acid may be either a cause or a consequence of the gall-bladder disease. Probably both conditions result from the same cause, intestinal toxemia, a condition which is responsible for a wide range of disorders of the human body.

It is evident then, that a strict antitoxic dietary, change of the intestinal flora, and frequent and thorough evacuation of the body residues (three times a day) are the dietetic measures likely to prove really efficient.

Pepsin of Little Value.

For half a century an enormous business has been done in the manufacture of pepsin from pigs' stomachs. Many tons of extract prepared from the lining scraped off the inside of the stomachs of hogs in our great slaughtering establishments are sold every year in the expectation that the deficiency of human pepsin may be made good by digestive ferment borrowed from the pig. Scientific research showed long ago that this enormous consumption of pepsin is of little or no value. As a matter of fact, the stomach rarely fails to make an adequate supply of pepsin. When gastric digestion is deficient, the fault is usually in the failure of the gastric glands to manufacture the necessary amount of gastric acid, so the thing wanted is not pepsin but acid. Notwithstanding the revelations which have been made by the exhaustive experiments of Morro and others, the pepsin business still flourishes. Pepsin is always secreted in abundance when acid is present. It is true, however, that in cases of extreme hyperacidity the pepsin is sometimes destroyed by the gastric acid, but this condition will not be remedied by the taking of pepsin. If the excess of acid is overcome, no further remedy is needed. How this may be done has already been pointed out (p. 647).

Bitters do not Stimulate the Stomach.

Another widespread delusion leads to the use of bitters in cases of this sort. The observations of Pavlov, Carlson, and others have clearly demonstrated that bitters do not increase the production of gastric juice. Reichmann and Scheffer have shown, in fact, that the presence of bitters in the stomach has the effect to lessen the secretion of gastric juice. From these experiments it is evident that the age-long faith in bitters as a means of promoting digestion has no scientific basis. Bitters hinder digestion rather than helping it. Scientific experiment does not even afford evidence that the use of bitters promotes appetite, or at least that any other than a slight psychic effect is produced.

Special Dangers in Achylia.

In persons suffering from achylia or extreme hypohydrochloria, the disinfecting action of the gastric juice is lost, and bacteria, and often molds, are found present in the stomach and small intestine, in great numbers. As a result the alimentary canal becomes thickly populated with putrefactive and other bacteria. A state of pernicious autointoxication is developed. In view of this fact, it is evidently important that foods which are likely to introduce bacteria into the intestine should be avoided. It is equally important to avoid foods which will encourage the growth of bacteria in the intestine, for the reason that the natural defense against these pernicious organisms has been broken down. On this account, meats of all sorts must be strictly prohibited. As shown elsewhere in this work, meats of all kinds, as supplied by the butcher, are swarming with bacteria and are in a state of active decomposition. The only exception to this general statement is found in the case of canned meats, which are necessarily made sterile by exposure to high temperatures in processing. Game, fish, shell-fish and oysters are especially detrimental and likely to give rise to grave and acute symptoms in persons suffering from achylia, when they might be eaten with impunity by persons possessed with gastric juice strong enough to exercise its normal disinfecting function.

Acute intestinal toxemia, or even ptomaine poisoning, is not always due to the use of food containing pernicious organisms. Such attacks may as well be the result of taking food which encourages the unusual development of virulent bacteria already present in the intestine.

Cold storage meats are especially objectionable, as are salted and smoked meats of all description.

For the same reason, certain varieties of cheese, such as limburger, brie, and all forms of cheese which are far advanced in the so-called "ripening" process, must be carefully avoided.

Eggs may be eaten in moderation when they are fresh and well cooked. Raw and half cooked eggs must be avoided.

Strong butter and rancid foods of all descriptions are exceedingly unwholesome, and are certain to increase the intestinal toxins by encouraging intestinal putrefactions.

Ordinary market milk is always unsafe, and is particularly dangerous in these cases as well as for young infants because of the presence of putrefactive organisms of various sorts, including the dangerous Welch's bacillus. Pasteurizing does not destroy the spores of these organisms and so does not render unclean milk safe. Only certified or clean milk should be used. Malted Nuts may be commended as a safe and very satisfactory substitute for milk in achylia.

Lettuce, celery, all forms of salad vegetables, and fresh fruits, must be carefully disinfected before being eaten (p. 312).

Persons suffering from achylia are much more exposed than are others to danger from infection by the embryos of animal parasites which develop in the intestine and with which raw fruits or vegetables are likely to become infected, both in the fields and when exposed for sale in the markets.

Such persons must also be continually on their guard against the use of bad water. Water containing typhoid germs, and even cholera germs, is often taken with impunity by persons whose stomachs contain an abundance of gastric juice, but in cases of achylia this protection is lost, and water-borne bacteria pass through the stomach into the intestine and there find conditions favorable for their development. If not known to be perfectly safe, water should always be boiled. In traveling, it is a good plan for persons known to have achylia to carry with them a small supply of water known to be pure, or made safe by boiling. In emergency, "chlorid of lime" (bleaching powder), may be used to render water safe. Five grains of fresh chlorid of lime added to a gallon of water will destroy in a few minutes any dangerous germs that may be present.

Persons suffering from achylia should avoid large meals. This is necessary for the reason that in achylia the stomach empties quickly. This is due to the fact that the pylorus is not closed by the presence of the gastric acid in the duodenum, as in the normal stomach. On this account, large meals must be avoided, otherwise the small intestine is likely to be overcrowded with food material and its function thereby disturbed. Meals should be made small and frequent. Some persons may take four small meals a day with advantage. Care must be taken to select foods which are quickly digested and to give preference to foods which are capable of being completely digested in the small intestine. Fortunately, this is true of most foods with the exception of raw or underdone meats, which are digested only by the gastric juice. Good reason for avoiding meats.

Thorough chewing is necessary not only because the foodstuffs remain but a short time in the stomach, but because the stomach has, to a large extent, lost its power of breaking up the particles of food and reducing them to liquid form, which is a necessary preliminary to intestinal digestion. Such liquid or semi-liquid foods as buttermilk, fruit juices, gruels, broths, purées of fruits and vegetables, especially purées of tomatoes, spinach and other greens, are to be most highly recommended in this condition. All fruit juices are valuable, and particularly the juices of acid fruits, for the reason that fruit acids are capable of replacing to some degree the normal acidity of the stomach. Fruits rich in vitamins are especially indicated for the reason that achylia is a degenerative state, and suggests the probable existence of other degenerative processes which may very likely have been occasioned by a diet deficient in vitamins. Orange juice is for this reason especially valuable.

Whole meal preparations should be used instead of fine wheat flour, macaroni and polished rice. In addition to whole grain meals, bran should be freely used. The laxative diet, elsewhere described (p. 580), is especially indicated in cases of achylia. Constipation is invariably present, together with chronic, intestinal autointoxication, hence a change of intestinal flora is essential (p. 552).

In every case of achylia, the intestinal motility should be determined at the outset of treatment. The stools should be examined and the fruit regimen with the other necessary measures elsewhere mentioned, should be employed until the flora is thoroughly changed, as indicated by the character of the stools, the disappearance of intestinal gas and of intestinal putrefaction and clearing of the tongue.

Two or three glasses of hot water may be taken with advantage half an hour before each meal as a means of cleansing the stomach.

A glass of orange juice or other dilute acid fruit juice half an hour before meals is especially valuable as a means of preparing the stomach for the intake of food.

ACUTE DILATATION OF THE STOMACH

Dilatation of the stomach is generally due to obstruction of the pylorus. An X-ray examination should be made. If obstruction is found, an operation is required. If no obstruction, restrict the diet to malt sugar and purées of cereals, potatoes and spinach, with fruits, fruit juices, vegetable broths and buttermilk.

In cases of acute dilatation, the stomach should be given complete rest, no food except sugar water prepared from milk sugar, malt extract or malt sugar. Raisin juice may be used. The juice of four ounces of raisins stewed in a pint of water will contain about 300 calories of sugar. It may be taken in its usual form or slightly thickened with cornstarch or agar.

When no acid is present, hydrochloric acid should be given in the form of acid protein (p. 642).

Small quantities of food should be given at frequent intervals.

MERYCISM

This term is applied to the regurgitation of food from the stomach, somewhat like rumination in animals. The regurgitated liquid may be acid or bitter, or may retain its natural flavor. Regurgitation is the result of loss of tone in the cardiac sphincter, in consequence of which it does not close the entrance to the stomach with sufficient vigor to prevent the contents from being forced upward to the mouth by the contraction of the stomach which takes place during digestion.

In certain persons, regurgitation only occurs on stooping or coughing violently soon after eating. Merycism is most likely to occur in persons who eat hastily, swallowing much air with their food, or on drinking too much liquid.

In some persons the act of swallowing fluids is accompanied by a gurgling sound, which indicates that air is being swallowed with the liquid. In such cases, rumination is likely to occur from distension of the stomach and from the presence of a large quantity of air which, accumulating in the upper part of the stomach, prevents contact of the gastric juice with the cardiac orifice, in consequence of which the sphincter muscle does not contract with sufficient vigor to keep the orifice closed. Moderate eating, thorough chewing of the food and avoidance of liquids at meals, are the dietetic measures indicated. The habit of regurgitation of the food when once formed becomes automatic and must be firmly and persistently resisted until overcome.

AEROPHAGIA

This is a condition allied to hiccough, in which air is drawn into the stomach in considerable quantities, the diaphragm being contracted, as in inspiration. While the epiglottis is closed, air is sucked into the stomach instead of into the lungs. Its causes are similar to those which provoke hiccough. The patient should resist the tendency to draw air into the stomach by taking ten deep breaths while holding the mouth widely open. It is well, also, to drink two or three glassfuls of very hot water.

The food should be moderate in quantity and rather dry, and should be thoroughly chewed. All causes of gastric irritation should be avoided, especially the use of condiments, tea, coffee, or very hot foods or drinks. Special attention should be given to thorough mastication.

CYCLIC VOMITING

In this distressing ailment, which occurs most frequently in children, meat and even eggs and dairy products should be carefully withheld. During the attack, no food should be taken into the stomach. The patient should be nourished by means of sugar water introduced by the colon. Malt sugar or syrup of raisins should be used for the purpose; two or three ounces of malt sugar to the pint, or the juice extracted from four ounces of stewed raisins, with the addition of water sufficient to make a pint.

HICCOUGH OR SINGULTUS

Hiccough may be induced by eating too rapidly or swallowing food in too large masses, or it may be caused by drinking carbonated waters, or the generation of gas in the stomach.

It may also result from the reflex irritation originating in disease of the gall-bladder or in the pelvic viscera.

Hiccough is also often due to an accumulation of irritating liquids in the stomach. Washing out the stomach, drinking copiously of hot water, and care to avoid the errors in eating above referred to, are the measures necessary to secure relief. When the hiccough occurs only after taking food, the patient may be nourished for a few days by nutritive enemas.

ACUTE GASTRO-ENTERIC INFECTION

This common disease of children requires the immediate and complete interdiction of milk and all animal foodstuffs. Thin barley or oatmeal gruel, rice jelly or rice gruel sweetened with malt sugar or milk sugar or sweet fruit juices and vegetable broths should be made the exclusive diet. The patient should be fed small quantities of food, the amount being gradually increased as tolerance is established. After a few days the diet may be made more varied. Purées of potato or other vegetables seasoned with a little butter may be added. Purées of spinach and other greens are especially valuable because of the rich stores of iron, lime and vitamins which they supply.

STOMATITIS

Rice jelly or a smooth rice gruel should be the exclusive food for a few days. Paraffin oil should be given to counteract the constipation, and the bowels should be made to move twice a day by the enema if necessary. Use Savita for vitamins.

URTICARIA

This disease is due in most cases to anaphylaxis (page 33). The offending substance may usually be determined by the skin test for sensitivity. Proper materials for this test are now provided, and it may be made by any physician who is familiar with the technic. In many cases the skin tests do not show sensitivity. In these cases, the cause is probably bacterial poisons produced in the colon.

When an offending food can be identified, this article must be scrupulously avoided. In other cases, the intestinal flora must be changed and a strict antitoxic dietary adopted. The writer has seen many cases recover as the result of the persevering use of these measures.

In many cases, the sensitivity to a particular foodstuff may be overcome by gradually accustoming the individual to it, beginning with very minute doses and gradually increasing. For example, in a case in which strawberries caused urticaria, the patient was given one strawberry the first day, two the next, and so on, adding one strawberry each day until a full serving could be eaten with no inconvenience. The cure accomplished in this manner may not be permanent, a fact which should be borne in mind.

NERVOUS DYSPEPSIA

The term nervous dyspepsia is usually applied to obscure cases of gastro-intestinal disorder in which no clearly defined disease can be made out. In the writer's experience, these cases are always highly toxic. Constipation is always present.

The proper procedure is, first of all, to change the patient's flora by the proper regimen (p. 552). When this is accomplished, the patient should adopt a laxative and antitoxic diet (pages 580 and 568), and an outdoor life. If these measures are thoroughly applied and carefully followed, the result will almost certainly be rapid progress toward health.

GASTRIC CATARRH IN CHILDREN

Jacobson reports that in cases of colitis in children he finds that the stomach shares the catarrhal condition of the bowels. He has treated these cases successfully as follows:

The child is restricted to water, only, for twelve hours, then for a few days raw oatmeal soup is administered; then half a pint of milk is given during the day, followed the next day by half a pint of milk gruel. The next day a pint of milk, a half pint of milk gruel and half a pint of water gruel. The diet is then made more liberal by the addition of toasted bread, sago soup, porridge and mashed potato. Milk sugar may be given with advantage; a teaspoonful three or four times a day.

The bland diet (p. 605) and buttermilk (*acidophilus*) should be employed together with treatment for colitis as in adults (p. 637).

DIET IN ACUTE GASTRITIS

This disease is rather rare. Most cases of so-called gastritis are simply cases of indigestion, not accompanied by actual inflammation of the gastric mucous membrane. When gastritis is actually present, the stomach should be given complete rest for one to three days. This does not mean, however, that nothing should be given the patient to swallow. Water, at the temperature of the body, should be given frequently, in small doses. The addition of milk sugar, or malt sugar to the water, in proportion of an ounce to the pint, is advantageous. Disease-producing bacteria will not grow, or at least are not virulent and active in producing toxins, in the presence of sugar. Mild fruit juices, as the juice of sweet oranges, and of raspberries well diluted, may also be advantageously used. Sometimes rice water or rice jelly is preferable, especially when great irritation is present. Whey, or still better, whey culture of the *B. acidophilus*, is clearly indicated.

When nausea, vomiting and other distressing symptoms have ceased, and water or rice water is well borne, well-boiled rice or rice gruel may be added, with buttermilk (*acidophilus*). As improvement progresses, the bland diet (p. 605), may be added.

Perfectly sweet butter and cream may be taken a little later.

Strong acids, spices, as well as tea and coffee, animal broths, and animal fats, must likewise be avoided.

Meat, especially, must be carefully avoided, as most harmful.

Care must be taken to avoid a relapse, which is very liable to occur. Great precaution must be exercised to avoid overeating and to masticate the food very thoroughly.

Special attention must be given to the bowels. If the stools are putrid, as is likely to be the case, the flora must be changed by the use of milk sugar and special cultures of *B. acidophilus*, which must be taken in doses of a half pint three times a day. Milk sugar should be taken freely; three ounces three times a day well diluted for several days.

DIET IN CHRONIC GASTRITIS

This disease is usually the result of frequently repeated attacks of acute gastritis occasioned by abuse of the stomach—alcohol, tea and coffee, overeating, the free use of meat, condiments—mustard, cayenne pepper, capsicum, horseradish, hot sauces, vinegar, spices, pickles, and smoking. Gastritis often accompanies cirrhosis of the liver, due to the same causes, and precedes and accompanies cancer of the stomach. It is usually present in pernicious anemia, and often accompanies chronic Bright's disease.

When vomiting is present, the same diet as in acute gastritis is indicated until the vomiting ceases; then farinaceous foods, with buttermilk, potato purée, rice pudding, bread pudding, cereal flakes, toast, zwieback, bran bread, rolls. Enemas must be given twice a day while the bland diet is used.

When free hydrochloric acid is present in the stomach, butter may be used sparingly, also cream, olive oil, egg yolk and egg yolk nog. As the stomach becomes less irritable, fruit juices and purées of fruits may be added. In all cases, purées of greens, spinach, lamb's quarters, red root, and other greens should be freely used as soon as the stomach will tolerate them. Herschell recommends fresh fruit alone for one meal daily in chronic gastritis, attributing special virtue to the fruit acids, which are doubtless highly beneficial. Cane sugar must be avoided. Malt sugar only should be used as sweetening.

Things to Avoid.

Meats of all sorts, broths, meat extracts, fish, oysters, pickles, vinegar, condiments, new bread, tea and coffee, much liquids at meals, pastry, cane sugar, preserves, confectionery, ice cream, ices.

AMYLACEOUS DYSPEPSIA

A general characteristic of so-called amylaceous dyspepsia is inconvenience from the presence of gas in either the colon or small intestine or both. When the small intestine is involved, the central portion of the abdomen, in the region of the umbilicus, is the chief seat of discomfort. The presence of much gas in the small intestine is due to two causes; excessive formation of gas in the colon and incompetency of the ileocecal valve, permitting the gas to pass from the colon into the small bowel.

Intestinal gas is chiefly produced by two organisms, the colon bacillus and Welch's bacillus. The last named organism, also known as the gas bacillus, is the great gas producer of the intestine. These organisms give rise to both fermentation and putrefaction. From protein they produce highly offensive gases; from starch or sugar they produce enormous quantities of carbonic acid gas.

The normal flora or bacterial vegetation of the human intestine, produces harmless acids and little or no gas. In the presence of the "wild" (Herter) putrefactive bacteria, saccharine or farinaceous foodstuffs give rise to much gas; but when the flora is changed, the gas at once disappears. This is a constant observation in the use of the fruit regimen or the milk sugar or dextrin method of changing the flora. At first, the gas is much increased; in a few days, however, the gas disappears although the amount of carbohydrates is not diminished or even is increased. So the cure for so-called carbohydrate or amylaceous or farinaceous dyspepsia is *more carbohydrate!*

In many cases, a cause of gas formation is the accumulation of food residues in the colon, especially the cecum. In such cases relief is readily obtained by means of a copious warm enema (three pints). The diet should be decidedly laxative, with bran or agar and paraffin. When adhesions of the cecum exist, the enema should be regularly used at night to insure complete emptying of the colon. Adhesions usually exist in cases of chronic appendicitis and in cases in which the appendix has been removed.

Distension of the bowels with gas is also a common symptom in colitis because of the spastic or contracted condition of the lower colon almost always present, causing retention of food residues and consequent fermentation and putrefaction with gas production in the cecum and ascending colon. A change of flora followed by a laxative and antitoxic diet will afford definite relief.

DIET FOR DECAY OF THE TEETH

One of the first to study the bacteria of the mouth was Miller, an American dentist practising in Berlin. He held that the cause of decay of the teeth was the fermentation of sugar and starch in the mouth. Miller experimented by placing teeth in fermenting mixtures of bread and saliva. He thought that he saw evidence of decay after several months.

Howe, of Harvard University, repeated the experiments, using saliva from persons with badly decayed teeth in mixtures of grape sugar, malt sugar, cane sugar, milk sugar, dextrin, and white flour bread. It was only after six months that he noticed etching of some of the teeth. There is really no evidence that fermentation of sugar or starch can cause decay of the teeth. Miller himself wondered why pigs which are fed almost exclusively on fermentable foods have such excellent teeth, usually free from decay.

Howe extended these experiments, feeding guinea pigs on foods deficient in vitamins. Not only the teeth but the alveolar process which supports the teeth, speedily showed evidence of injury. First, there was marked loosening of the teeth, and later, caries appeared. The gums became soft and bled easily. The teeth became brittle and carious. After feeding green leaves or orange juice, the symptoms quickly disappeared.

It is a notable fact that the teeth of primitive people are almost invariably free from decay. Dr. Ottofy, who examined the teeth of many Igorot children in the Philippine Islands, found more than two-thirds with perfect teeth, and the defects in the remainder were so slight as to be almost undiscoverable.

Decay of the teeth is reported to be unknown among the Eskimos.

The Highlanders of Scotland have excellent teeth, doubtless because they still adhere to the diet of brose, bannocks, buttermilk and potatoes, which rendered their ancestors famous for physical prowess. The Scotch people who dwell in the lowlands have adopted the modern vicious habits of diet, and as the result, their teeth show much evidence of decay.

Soft foods, foods poor in lime and vitamins, and meats of all sorts encourage dental decay and pyorrhea. The fibers of meat caught between the teeth encourage the growth of the sort of germs which cause decay of the teeth.

The use of hard, dry foods which require vigorous use of the jaw muscles and promote the flow of saliva is essential for good development of the teeth. Greens, coarse vegetables, bran, and acid fruits which stimulate the flow of saliva are all important means of promoting the health of the teeth. Cane sugar, fine flour bread, very hot foods and drinks and meats are most objectionable from the standpoint of dental hygiene.

Mellanby showed that the fat-soluble vitamin A is necessary for the proper development of the teeth. Marked difference was found between the teeth of animals fed on linseed oil and those fed butter fat. Butter fat contains the fat-soluble A in abundance, whereas linseed oil contains little or none.

At the suggestion of Dr. Vida A. Latham, the Indians confined in government jails have been required to give special attention to cleansing the teeth in accordance with the rules of oral hygiene. The result has been that the sickness from dysentery, which had formerly been very prevalent in the jails, has been decreased more than 50%. There is a growing mass of facts which clearly indicate that a foul condition of the mouth may lead to infection, not only of structures immediately connected with the mouth, but of the stomach and intestines as well. Infection of the mouth and decay of the teeth are encouraged by the use of flesh foods more than by any other means.

The substitution of milk for meat in the dietary, the free use of greenstuffs which abound in food lime, avoidance of confectionery, the use of malt sugar, dates, figs or raisins in place of cane sugar, and especially the use of dry, hard food that will give the teeth and jaws exercise, are the most important dietetic precepts relating to dental dietetics. Every child should have at least one quart of good clean milk daily.

The intestinal flora must be changed (p. 552) and kept in a normal state. The bowels must be kept free by the use of bran or agar and mineral oil, and a laxative diet (p. 580).

DIET IN INTESTINAL OBSTRUCTION

In cases of intestinal obstruction, surgical measures are indicated, and should be resorted to at the earliest possible moment. In the meantime, while preparation for more radical measures are being made, several things of importance may be done.

Half a pint of warm water with an ounce of malt or milk sugar should be given by enema hourly. When possible, the duodenal feeding tube should be used. By this means, the putrid and highly toxic duodenal contents may be pumped out and sugar water introduced, greatly to the patient's advantage. Some portion of the sugar will be absorbed, giving valuable re-enforcement to the patient's flagging energies, especially sustaining the heart much more effectually than caffein or any other drug can do. The sugar also has the effect to modify bacterial changes, preventing the development of putrefactive products and other bacterial toxins. Sugar water is prepared by dissolving in warm water two ounces of malt sugar or milk sugar.

In the writer's hands, this plan of feeding a patient suffering with intestinal obstruction has proved invaluable, and in several instances has been the means of saving the patient's life.

After an operation for enterostomy has been performed for intestinal obstruction, lactose or malt sugar, two ounces to the pint, should be used for irrigation of the intestine, the effect being both to nourish the patient and to suppress putrefactive changes which are always actively present.

The observation by Case that intestinal obstruction may be discovered by examination with the X-ray, which reveals the abnormal distension of the intestine, is highly important as a means of early diagnosis.

DIET FOR ULCERATION OF THE COLON

The diet in ulceration of the colon is the same as that for colitis (see p. 637). It is not necessary to suppress bran and other roughage. This element of the food is necessary to promote bowel movement. The thing necessary for recovery in these cases is not a bland diet but cleanliness of the colon. Nothing is so irritating to the diseased surfaces as the presence of putrefying residues. The irritation of the colon is caused, not mechanically, but chemically, by the products of putrefaction.

Agar may be used freely, and paraffin oil should be taken with each and every meal. Large enemas of starch water with milk sugar (an ounce to the pint), and, if possible, several ounces of whey cultures of the *B. acidophilus* should be used daily. Acidophilus-Lactose one to three ounces three times a day for one or two weeks should be given to change the intestinal flora. This is always necessary.

DIET FOR HEMORRHOIDS

The diet to be employed in a case of hemorrhoids is essentially an antitoxic and laxative dietary. Bran should be freely used to the extent of one half to an ounce daily. The bowels should be kept loose; should be moved three times daily. Patients sometimes complain of increased irritation due to frequent bowel movements, particularly when the enema is used. This difficulty can be usually obviated by taking care to cleanse the parts thoroughly after the bowel movement, and to apply to the anal canal a little carbolated vaseline.

Large hemorrhoids may often be made to disappear by the daily application of a powder consisting of equal parts of starch and calomel, after first carefully cleansing the parts.

The idea that the use of bran and coarse vegetables may produce or aggravate hemorrhoids by mechanical irritation is wholly an error. Bran does not irritate, it titillates.

DIET IN APPENDICITIS

Appendicitis is the result of an extension of infection from the colon to the appendix. Nothing can be done by diet for an acute attack of appendicitis since all food should be suppressed until after the patient gives marked indications of recovery or has been subjected to the operation indicated. It is highly probable, however, that appendicitis may be prevented by a proper regimen, or at least that it is much less likely to occur when a special regimen is followed and so-called chronic appendicitis is usually curable by changing the intestinal flora.

Many years ago, Dr. Lucas-Championnière, the Surgeon-General of the French army, discovered that appendicitis is a disease to which meat-eaters are especially liable. During a military campaign in Africa, he noted that appendicitis was very common among the French soldiers who were fed canned meats, but almost unknown among the Arabs, who lived upon a diet of wheat cakes, camel's milk and vegetables.

He later observed that appendicitis was practically unknown in the prisons and insane asylums of France, where meat is not used, except in the case of newly admitted inmates.

Senn, of Chicago, observed that appendicitis was unknown among the vegetarian natives of the East African coast.

Dr. McCord, who has practised for more than thirty years among the natives of Natal, states that appendicitis is the rarest of maladies among these people by whom meat is rarely eaten.

Crichlow reports that appendicitis is unknown among the natives of the Solomon Islands so long as they adhere to their native diet, which is almost wholly of vegetable origin.

Dr. Snyder, for ten years physician to the Shah of Persia, met only ten cases during that time in Teheran, three of which were Europeans and one a native student just back from Paris.

Dr. Magnon, physician to the French Embassy at Pekin, met among the Chinese only one case of appendicitis in five years. The staples of the Chinese diet are millet, rice, sweet potatoes, turnips, cabbage, soy beans, greens, cornmeal and wheat meal.

Flesh-eating encourages the development of appendicitis for the reason that all meats, as ordinarily eaten, including fish and fowl, contain in a state of luxuriant growth virulent forms of bacteria which are capable of producing infection of the colon and of the appendix. For this reason, game, cold storage meats and meat that has been hung until tender, are particularly likely to give rise to this disease.

Persons who have been subject to attacks of appendicitis and have recovered, should discard meats of all sorts, especially fish, including oysters, and should take care to keep the colon empty by three regular movements daily.

Efficient measure should be taken for changing the intestinal flora (p. 552). The stools are always putrid in persons subject to attacks of appendicitis. Such persons should not rest until they have made such modifications of their diet as to cause a decided change in the stools, including the disappearance of the putrid odor and of the mucus which is nearly always present on account of the coexistence of colitis.

After an operation for appendicitis, the antitoxic diet (page 568), should be permanently adopted and should be faithfully adhered to as a permanent regimen. There is no danger of the recurrence of inflammation of the appendix, since this organ has been removed, but the same sort of infection which produced the appendicitis still exists in the colon and will be perpetuated by the continuance of the diet which induced it in the first place. The danger from infection of the colon is less acute and immediate than that from infection of the appendix, but the autointoxication which it induces may later produce equally calamitous results.

DIET FOR "BILIOUSNESS"

"Biliousness," an unscientific term, is generally used to designate a condition of general *malaise,* loss of appetite, dullness, constipation, and general "unfitness." This condition is usually attributed to "torpidity" or inactivity of the liver, and calomel is the usual prescription, especially in the South, one of its chief properties being supposed to be to increase the activity of the liver.

As a matter of fact, calomel does not increase the activity of the liver. This was shown by Bennett, of Edinburg, more than a hundred years ago by experiments upon dogs. Bennett found, in fact, that calomel lessens the amount of bile produced by the liver instead of increasing it. Modern investigators have confirmed these findings; but the use of calomel still continues and the users testify that they find relief by its use, at least temporarily. This is not to be disputed. It is this immediate relief which maintains confidence in this antiquated drug.

The explanation is to be found in the fact that "biliousness" is not due to deficient secretion of bile or to sluggishness of the liver, but to autointoxication, arising from retention of putrefying food residues and body wastes in the colon. Calomel acts as a laxative and a disinfectant. Its use causes the discharge of a quantity of bile which has become concentrated and toxic by re-absorption. Getting rid of these poisons affords relief from the symptoms commonly called "biliousness" and other evidences of toxemia.

Unfortunately, the relief is only temporary, and still more unfortunately, the relief is not the only result. Some of the calomel is converted into corrosive sublimate and is absorbed as such, and poisonous effects are produced. The liver is damaged, and other evil effects result, among which is colitis.

It is thus most desirable to avoid the use of calomel, and to combat the evil conditions for which it is employed in some other way. Fortunately, this may be done, and by very simple means. Here are the measures which may be adopted with the certainty of good results.

Omit from the diet meats of all sorts and also for a time, eggs. Buttermilk may be used freely and all sorts of fresh vegetables, particularly turnips, greens, celery, cabbage and lettuce, with fruits and fruit juices. Two large tablespoonfuls of bran should be taken at each meal.

The flora must be changed by the fruit regimen with three ounces of milk sugar or two ounces of Acidophilus-Lactose three times daily for a week or ten days. A cleansing enema should be taken every night to thoroughly empty the colon.

After recovery from a "bilious attack," the antitoxic and laxative dietaries should be definitely and permanently adopted. Care must be taken to move the bowels three times a day, using an enema at bedtime if necessary to secure complete emptying of the colon.

DIET FOR GALL BLADDER DISEASE

Infection of the gall bladder, either with or without gallstones, as is the case with other cavities of the body, is chiefly due to stasis or stagnation of its contents. When the gall bladder is not fully and frequently emptied, it becomes an incubating chamber. The bile is not a real antiseptic, and when charged with mucus, as it always is when diseased, it becomes a most excellent medium for the growth of putrefactive bacteria and other disease-producing organisms. On this account, it is highly important in cases of this sort to secure as complete and frequent emptying of the gall bladder as possible, thus lessening the opportunity for the growth of bacteria and the development of virulent strains of bacteria.

Something may be done toward the emptying of the gallbladder by the cool enema (85° to 75° F.), which stimulates contraction and thus empties the bile reservoir. Free water drinking (5 to 6 pints daily) thins the bile and encourages its passage into the intestine. But the most effective means of exciting contractions in the gall blad [illegible] the taking of food. When food is taken into the stomach and begins to pass out into the duodenum through the pylorus, the contact of the acid mixture of gastric juice and food with the lining membrane of the duodenum, excites powerful contractions in the gall bladder. On this account, it is better for these patients to take small quantities of food at frequent intervals, preferably four times a day. Two major meals may be eaten and two minor fruit meals, the latter two hours before meal-time, so as to secure complete emptying of the stomach before the next meal. The late Professor Dujardin-Beaumetz called attention to this fact so long as thirty years ago. A point which the professor overlooked is the need of making a careful selection of foodstuffs when four meals are taken. First of all, the food should be easily digestible, and of a sort which leaves the stomach quickly. Fruit fills the indications exactly, and should constitute the sole food taken at the minor meals. Rice gruel or plain potato purée may be used when fruit does not agree.

The fruit regimen (p. 532) to change the intestinal flora is always indicated.

CIRRHOSIS AND OTHER DEGENERATIONS OF THE LIVER

The liver is crippled in all its functions. It has been required to deal with such enormous quantities of toxins that it has been prematurely worn out. Its work must be made as light as possible by changing the intestinal flora with Acidophilus-Lactose or other of the means pointed out in other chapters (p.552), so as to suppress the formation of putrefaction products in the colon, and also by avoiding all excess in the use of sweets, since it is a part of the duty of the liver to metabolize sugars. Meats of all sorts, condiments, all excess of food and especially of protein and fat must be carefully avoided. Copious water-drinking and attention to personal hygiene in all particulars are other necessary measures.

M. T. V. Tallqvist (*La Semaine Médicale*), in extended dietetic experiments made upon persons suffering from catarrhal jaundice, inflammation of the gall-bladder, gall-stones, and hepatic sclerosis due to cardiac diseaeses and other forms of disease of the liver due to intestinal autointoxication, observed that in order to produce nitrogenous equilibrium it was necessary to employ much larger proportions of carbohydrates than in the normal state. This is doubtless due to the disturbance in the hepatic functions set up by the toxins absorbed from the alimentary canal. The fruit regimen is of great service in these cases.

DIET IN DISEASE OF THE PANCREAS

This disease, formerly considered rare, is now known to be of comparatively frequent occurrence. The pancreas is especially exposed to disease because of its connection with the gall duct. The outlet duct of the pancreas and the bile duct usually enter the intestine through the same opening, the two ducts usually joining just back of the opening into the intestines. When infection with chronic inflammation of the gall bladder and gall-ducts occurs, a common result is a partial obstruction of the outlet which causes a backing up of bile in the pancreatic duct. The bile, reaching the pancreas, probably activates the pancreatic juice and causes auto-digestion of the pancreas, which in turn gives rise to infection and inflammation, either acute or chronic. In many cases this process goes on for many years without producing any considerable amount of pain, although a common result is diabetes, which accounts for the observation made by several eminent authorities that meat eating is an active çause of diabetes. Sometimes, through the formation of cysts, the development of calculi or other causes of obstruction, pancreatitis may be accompanied by paroxysms of severe pain.

It is evident that in all cases of pancreatitis a strictly antitoxic dietary should be followed. The diet should be essentially the same as that recommended for gall stones and cases in which operations have been performed upon the gall bladder. It is especially important that meats of all kinds should be discarded and that the colon should be kept free from putrefying residues. The diet should be such as to secure three full movements daily, the enema being used daily, if necessary, to accomplish this. The flora must be changed (p. 552).

While surgical drainage of the gall bladder affords the only radical means of relief, regulation of the diet is of the highest importance.

In cases in which sugar has not appeared in the urine and the blood sugar has not increased, as well as in cases of diabetes, the antitoxic dietary is especially indicated (see p. 568).

Copious water drinking and the use of acid fruit juices are highly beneficial. Condiments of all kinds must be excluded from the bill of fare, together with tea and coffee.

DIET IN DIARRHEA

Diarrheas are generally due to infection, the increased activity of the bowels being a remedial effort to eliminate poisons of bacterial origin. There are many micro-organisms which are capable of giving rise to diarrhea. Those which are most active are found in impure drinking water, usually being derived from the stools of human beings through contamination of the water with sewage, in milk, eggs, meat and stale fruits.

Chronic diarrhea is often a symptom of inactivity of the colon. It is not infrequently found in cases in which eight or ten bowel movements occur daily, that the colon, especially the right half of it, is filled with fecal matters, never being perfectly emptied, and this retention of irritating, putrefying material is the real cause of the diarrhea. In such cases, it is necessary to increase the efficiency of the colon in order to unload it before any progress can be made toward the control of the disease. The colon should be thoroughly emptied by the administration of copious warm enemas. The enema should be repeated until the water is no longer colored with fecal matter.

Bran or agar and paraffin oil are indicated in connection with the laxative diet (p. 580). The intestinal flora must be changed and the antitoxic diet closely followed. Boil drinking water and disinfect fruits, lettuce and celery.

Diet in Acute Diarrhea.

When the diarrhea is due to acute infection, the condition is usually accompanied by rise of temperature.

First of all, in case of acute diarrhea, the patient should be put to bed and the diet should consist of water only, or water containing two or three ounces of milk sugar to the pint, or of thin oatmeal or rice gruel. Eight or nine ounces of milk sugar should be taken daily by an adult. Whey cultures of the *B. acidophilus,* in doses of half a pint by mouth three or four times a day, are most useful. Acidophilus-Lactose is still more efficient.

Milk, eggs, animal broths, all foodstuffs rich in protein, should be avoided. The colon should be washed out two or three times a day by a hot enema, and a fomentation followed by a moist abdominal bandage should be applied to relieve the intestinal congestion. Repeat the fomentation two or three times a day, not only to relieve pain, but to relax the contracted colon and thus aid in completely emptying it of its irritating contents.

In children, milk should be avoided altogether. Instead, for seasoning, a little almond cream or nut meal may be added to the gruel. Buttermilk, prepared with the *B. Bulgaricus* or *B. acidophilus,* is an excellent diet for a few days after convalescence begins, and helps to complete the change of flora. One to two quarts of buttermilk should be used daily.

Loeper has shown that the loss of calcium through the stools in diarrhea may be so great as to give rise to purpural hemorrhages, tetany, epilepsy, urticaria, itching of the skin, erythema, neurasthenia and loss of weight.

It is evident that these serious effects of the loss of calcium may easily be aggravated by the long use of a diet consisting only of bland gruels prepared from cornstarch, fine flour and similar preparations which are known to be lacking in lime and calcium as well as vitamins, to the absence of which some of the symptoms noted may be due.

No attempt should be made to correct the diarrhea by means of a constipating diet. The looseness is not due to mechanical causes but to infection. It is necessary that the flora should be changed as promptly as possible. In most cases this is accomplished by the free use of dextrin or milk sugar, which should be given in quantities of two and a half to three and a half ounces, or two ounces of Acidophilus-Lactose, three times a day.

As soon as the diarrhea is checked, foods rich in lime should be administered. Cottage cheese, whey, buttermilk, purées of spinach and other greens are the best foods for rapidly making good a deficiency of lime.

The diet should also include sweet or mildly acid fruits, purées of vegetables, cereal, gruels and porridges. A day or two later, oatmeal porridge, bran brose, graham bread and stewed fruits may be added, and within a day or two more the regular anti-toxic and laxative diet (pp. 568, 580), may be adopted, and should be adhered to as a regular regimen.

If the stools again become very foul or strong smelling, the intestinal flora certainly needs to be changed. It is well to apply the motility test (p. 518).

DYSENTERY

In dysentery, the plan of feeding should be essentially the same as that for diarrhea, in the acute form of the disease. In addition, a warm starch enema should be administered three or four times a day. The addition of half an ounce of milk sugar to a pint of starch solution is a most excellent means of combating the colonic infection.

In chronic dysentery the diet should not exclude roughage, but care should be taken that the roughage is of the right sort. Agar may be used safely in quantity from one ounce to one and a half ounces, daily. Even bran, when well cooked may also be used in connection with other cereals. Greens should be used freely in form of purée as roughage and for their iron content and vitamins.

Meats of all sorts must be strictly excluded, of course, as they will only aggravate the disease by promoting the growth of the bacteria to which the infection is due. Rice, buttermilk, brose, potato soup, vegetable broths and purées of greens, are particularly suitable for cases of this sort.

The intestinal toxemia which often follows diarrhea or dysentery requires a special regimen to change the intestinal flora (p. 552).

DIET IN TROPICAL DYSENTERY

The diet in tropical dysentery does not differ from that of ordinary dysentery, which should be employed in connection with proper medication and other measures necessary for the eradication of the infection.

DIET IN INCOMPETENCY OF THE ILEOCECAL VALVE

Although the ileocecal valve has been known as an anatomical structure since 1579, or nearly 350 years, its significance has not been fully appreciated until very recent times. The small intestine is the chief digestive and absorbing organ of the body. Within eight hours after the eating of a meal, the digestible and useful portions of the food have been digested and absorbed and the unusable residue has been pushed through the ileocecal valve into the colon. When intact, the valve closes after the food residues have passed through it and prevents their return to the small intestine. This is highly necessary for the reason that in the colon the food residues, if long retained, undergo putrefactive changes through which highly toxic substances are produced some of which are equal in virulence to the venoms of snakes.

The structure of the colon is such that these poisons are absorbed only to a small extent and are mostly filtered out. In the small intestine absorption is very rapid, more than twelve times as rapid as in the colon, and poisons present in the intestine are readily taken up into the blood. It is, hence, highly necessary that residues and wastes which have been passed from the small intestine into the colon should never be permitted to return.

Another and very important reason why the ileocecal valve is essential is a curious function which was first discovered by Cannon in animals and demonstrated by Case in human beings.

While digestion is taking place in the stomach and small intestine and strong peristaltic waves are forcing the food residues into the colon through the ileocecal valve, reverse or antiperistaltic waves, starting at the middle of the colon, travel backwards for the purpose of holding the liquid materials for a brief period in the cecum where they have been deposited from the small intestine. The object of this is to allow time for the absorption of water and to prevent the highly liquid material from passing rapidly through the colon, as it otherwise would do, giving rise to almost constant bowel movement. As these reverse waves move rapidly backward from the middle of the colon toward the ileocecal valve, the liquid contents of the cecum are forced strongly up against the valve but do not pass it so long as the valve is intact, for it is a most efficient check valve. But when the valve is defective, these surging reverse movements force the liquid food residues in the cecum back into the small intestine. This action in cases of incompetency of the ileocecal valve is sometimes so strong, especially after the work of digestion in the stomach and intestines has been completed, that several feet of the small intestine may be filled with fecal matters forced back from the colon.

In this way the putrid materials with which the colon is often filled, may find their way into the intestine, and the infection traveling upward may reach the gall bladder, the pancreas, even the stomach, giving rise to catarrhal inflammation, gall stones, pancreatitis, probably also duodenal and gastric ulcers and other disorders. According to A. Schmidt, putrefaction should never occur anywhere in the intestine except the colon, and in perfectly normal conditions with a proper dietary, which must necessarily exclude meats, putrefaction does not occur even in the colon. Says Schmidt: "The ileocecal valve forms a sharp line of demarcation above which putrefaction never occurs except under pathological conditions. If protein decomposition extends up into the small intestine, far greater quantities of indican appear in the urine than ever occur through the absorption in the colon."

Incompetency of the ileocecal valve interferes with the advancement of gases even more than with the movement of liquid material. It is on this account that patients in whom the ileocecal valve is wholly incompetent are usually subject to a most distressing accumulation of gas in the intestine. The abdomen is greatly distended, and while small quantities of gas escape from time to time by mouth and anus, complete relief is never obtained.

The crippled ileocecal valve may be repaired by a suitable operation, and this operation has been done in many cases with marked benefit to the patient. But the operation alone is not likely to be a permanent success for the reason that it deals only with a result, the cause of the trouble existing farther along in the colon.

From the above it will readily appear that a rigid antitoxic diet is of the highest importance in cases of this sort. The food should be of such a character that the residues will not encourage putrefaction even if delayed for some time in the colon. If putrefaction in the colon is suppressed, the injuries resulting from a backing up of the colon contents into the small intestine will be largely obviated. In such cases the diet must be not only antitoxic (p. 568), excluding flesh meats of all sorts, but also highly laxative (p. 580), so as to encourage frequent bowel action. The bowels should be made to move three times daily, by diet if possible, ordinary foods being supplemented by the free use of bran or agar and paraffin oil. If the bowels do not move freely three times a day, the colon should be emptied at night by means of a warm or tepid enema. The quantity should not be more than three or four pints. The best temperature is 90° to 80 degrees F. The intestinal flora must be changed (p. 552).

ATONIC CONSTIPATION

Constipation is often attributed to an atonic condition of the colon. In this state the colon is widely dilated, as shown by X-ray examination, and constantly contains large quantities of gas. The walls of the colon seem paralyzed, the gut appearing to have lost its power to expel its contents. This condition is usually regarded as a disorder of the nerves which supply the colon. In the writer's opinion, the condition is due rather to the effect upon the colon of the putrefying materials with which it is filled. In such cases the stools are always highly putrid and have a most repulsive odor because of their long retention and the very advanced stage of putrefaction. In such a condition a large amount of ammonia and other alkaline substances are present in the colon. It is well known that alkaline substances paralyze the colon, while acid substances stimulate the muscular structures of the colon and cause contraction. That the colon is not paralyzed even in these cases is shown by the fact that by the introduction of an enema containing citric or lactic acid vigorous bowel movements may be secured. The addition to the enema of the juice of a lemon or a half tablespoonful of lactic acid rarely fails to secure prompt contraction and expulsion of the colon contents. This may be expected, in fact, in all cases in which there is no serious mechanical obstacle to bowel movement.

It is of the highest importance, then, in these cases, to change the intestinal flora (p. 552), so that the colon contents will become acid instead of alkaline. This must be done to secure permanent improvement. This may be accomplished by means of the fruit regimen. Much more rapid progress may be made in changing the flora by introducing into the colon, daily, cultures of the bacillus *acidophilus* or *B. bulgaricus* or a mixture of the two. The introduction of a half pint of an active solution of the *B. acidophilus* after the colon has been emptied by a warm enema containing lactic or citric acid or a few ounces of malt sugar greatly facilitates the change of the intestinal flora. Acidophilus-Lactose by mouth and rectum is most efficient.

The diet should be made permanently laxative and antitoxic (pages 580 and 568). It should contain sufficient quantities of bran or agar, fresh fruits, fresh vegetables, especially greens, to secure three full bowel movements daily. A warm enema should be used daily, if necessary, to secure complete clearance of the bowel.

TAPEWORM

There is no dietetic treatment by which the tapeworm may be expelled from the alimentary canal. Suitable vermifuge treatment is necessary. It is important, however, to impress upon the patient the fact that this disease can be contracted in no other way than by the use of flesh food, either beef, pork or fish.

The fish tapeworm produces more serious injury to health than does either the beef or pork tapeworm, often giving rise to a very pernicious anemia.

In the treatment of tapeworm, it is very important that the patient should eat very sparingly for several days before the treatment is undertaken, and to prevent a recurrence of the disease, it is equally important that flesh food or at least flesh foods likely to harbor the parasite, should be entirely discarded.

DIET IN OESOPHAGEAL STRICTURE

In this condition, the diet must be fluid. It is a mistake to use meat broths, bouillon, albumin water, etc. These preparations have little food value and encourage acidosis, which on account of the restricted amount of food which can be taken, is likely to supervene.

Malt sugar is in these cases of great value. From 1200-1600 calories may be given daily. When malt sugar is not available, the sugar of raisins may be utilized. Raisin juice may be obtained by boiling four ounces of raisins in a pint of water for half an hour. This amount contains about 300 calories of sugar.

Rice jelly, or rice purée, egg yolk-nog, vegetable broths, potato purée, spinach purée, sweet corn pulp and similar preparations, are indicated. Farinaceous foods of all sorts should be well mixed with saliva before being swallowed. These dietetic measures are of course not curative. They are to be used simply to keep the patient alive until radical means of relief can be applied.

DIET IN DISORDERS OF NUTRITION

While food is by no means the only agent by which the nutrition of the body may be influenced, it is certainly the most powerful. By suitable feeding, the weight may be increased or decreased, the iron, lime and other saline constituents of the tissues may be augmented or diminished, cell activity may be excited, the activities of the kidney and other glands may be promoted or lessened, and the work of various parts of the digestive organs may be increased, facilitated or lessened.

DIET IN OBESITY

Before beginning a course of diet to reduce weight, it should be determined how much the weight is to be reduced. Suppose, for example, a person whose original and normal weight was 120 pounds, now weighs 200 pounds; it would be most unwise to reduce such an individual to his original proportions. Ordinarily, in a case of this sort it is wiser to be content with reduction of the weight to 160 or 165 pounds; that is, not more than half or two-thirds of the surplus weight should be removed. In the case of persons who have become exceedingly obese, the weight being increased from two and one-half to three times the original weight, it is not best to undertake to remove more than one-third of the surplus. After this has been accomplished, some further progress may be made by very slow reduction so as to permit the tissues to accommodate themselves to the changed relations which result from the removal of a large amount of accumulated internal fat.

It is important to notice before beginning a course of diet for fat reduction just where the largest masses of fat are deposited, especially whether the surplus abdominal fat is outside or inside. In many cases, the excessive accumulation is almost wholly within the cavity of the trunk, the fat being deposited in the omentum, the mesentery, about the kidneys, around the heart and in other parts of the chest and abdomen. In other cases, the fat accumulation is almost wholly external, large masses being heaped about the abdomen, the hips, sometimes about the shoulders, upper arms and thighs. In women, the breasts are not infrequently the seat of over-fat accumulation.

A simple method of detecting the location of the abdominal fat consists of having the patient lie down and raise the extended legs. If the fat accumulation is within the abdomen, the play of the abdominal muscles may be easily seen as they are made tense when the legs are raised, and if the skin and underlying fat is grasped between the hands at the lower abdomen when the legs are raised, it will be noticed that the contracted muscles are readily felt and the mass which may be gathered between the hands when the muscles are lax is snatched away as soon as the muscles are tensed by the raising of the legs. On the other hand, if the fat is external, a large mass remains between the hands when the legs are raised. When the chief accumulation of fat is internal, the patient usually suffers greatly from shortness of breath because of the great deposit of fat about the heart, and fatty degeneration as well as fatty infiltration of the heart muscle may exist. This condition often presents an insuperable obstacle in the way of taking a sufficient amount of exercise to accelerate the fat reduction to any considerable degree.

Having decided how much fat reduction is required, the next question is the determination of the amount of the daily ration; that is how many calories shall the patient eat for breakfast, dinner and supper. First of all, we must know what would be the normal ration for the individual. If he weighs 210 pounds, and we determine to reduce his weight to 170 pounds, then by reference to the table we may ascertain what is the basal ration for a person weighing 170 pounds. We find this to be about 1,900 calories. This makes no allowance for exercise, which would probably increase the patient's ration about 50 per cent. making it 2,800 calories. Halving this will give us 1,400 calories for the daily intake of the first week.

The next question is what kind of food shall the patient be allowed to eat? First of all, it is important that the patient should be instructed concerning foods which are highly fattening and which on this account must be avoided. These are, particularly, fats of all sorts, sugar, including candy, rich gravies, pastry and potatoes. Breads and breakfast foods must also be greatly restricted. On the other hand, there are certain foods which the patient may eat freely, almost without restriction. These are, especially, fresh vegetables of all kinds, with the exception of potatoes, and juicy fruits, green things, particularly cabbage, lettuce and fresh cucumbers. Lettuce and greens should constitute a large part of each meal.

The sense of satiety, or the satisfaction of hunger, is largely the result of distension of the stomach, and hence bulky foods will satisfy the patient and make him feel that he has enough to eat even though the intake of food as reckoned in calories is very small. It is well, also, to allow butter in very small amounts as this greatly aids in producing the sense of satiety. The amount should not exceed a half ounce daily.

Greens and greenstuffs, especially uncooked foods, are particularly valuable and should be made the major part of the diet because of the large amount of vitamins which they contain. In reducing the diet, the intake of vitamins is proportionately reduced, but there is no possible benefit from such a reduction. On the other hand, the diet of the average person is very deficient in vitamins, so in the obese patient more rather than less vitamins should be given, and this can only be accomplished by the free use of greens and fresh foods. The reduction of food also tends to produce anemia. This danger is also obviated by the free use of greens, which supply an abundance of food iron.

The amount of protein required is not increased and should never be more than one calory per pound of body weight. An excess of protein is the grievous fault in all the many regimens heretofore recommended for fat reduction. It is true that lean meats do not contribute largely to the production of fat, but it is equally true that the large intake of protein imposes an enormous and onerous burden upon the liver and kidneys while serving no useful purpose to the patient. Surplus protein, as shown by Folin, is simply eliminated as urea and contributes nothing to the welfare of the body. A meat diet greatly increases the liability to acidosis.

The necessary bulk can be easily secured by the free use of greens, fresh fruits, fresh vegetables, and bran or agar. A half ounce of bran should be taken at each meal or a third of an ounce of agar. Paraffin oil should also be taken to secure active movements of the bowels, which are likely to become constipated when the intake of food is cut down. A tablespoonful of paraffin oil should be taken before and after each meal and also, if necessary, at bedtime. Buttermilk, whey, skimmed milk, and cottage cheese may be freely used and are a good source of food lime and vitamins.

The fat reduction is to be secured by reducing the intake of fats and carbohydrates. Fats may, in fact, be wholly eliminated from the dietary for long periods without injury, as shown by the observations of Hindhede referred to elsewhere in this work. (For further suggestions see "The Reducing Diet," p. 601).

It is sometimes advantageous to put the patient upon a "Mono" diet. For example, he may be allowed, one day, to eat apples, another day peaches, still another day pears, another day lettuce, celery and salads of various sorts, either alone or combined with fruits. Even nuts may be allowed in moderation. A very acceptable diet may be arranged on a menu consisting of apples, bananas, almonds or Brazil nuts. It is only necessary to take care always to keep the total intake of calories within the limits, that is, not exceeding half or two-thirds the normal ration.

After the first week or ten days the intake of food should be increased 50 per cent, and this reduced dietary, which furnishes about three-fourths of the total energy requirement of the individual, may be continued for several weeks or even months. After a few weeks, the amount of food should be increased a little more, to four-fifths the normal requirement, and later, to five-sixths. Care must be taken to supply each day all the protein, vitamins, lime and iron the individual can possibly need, and when this is done no possible harm can come from the dietetic restrictions. The injury which many persons suffer when trying to reduce the weight by dieting, results from some one of the following causes:

1. Too long fasting, producing injury from acidosis and loss of muscular tissue, weakening of the heart, etc.
2. Excessive intake of protein, overworking the liver and kidneys and increasing intestinal putrefactions.
3. Deficiency of vitamins, leading to general malnutrition and sometimes symptoms of scurvy or polyneuritis.
4. Deficiency of food lime, leading to a condition of lassitude, loss of muscular tone and a state of general asthenia.
5. Deficiency of iron, leading to anemia and general loss of vigor and vitality.
6. Constipation and intestinal toxemia, resulting from reduction in the volume of the food and deficiency of roughage.

The comparative inefficiency of exercise as a means of reducing weight will be clearly shown by a little computation:

According to the observations of Zuntz, the amount of work done by a man walking 13.4 feet, at the rate of three miles an hour, is the same that would be required in the lifting of his body, vertically, one foot. In walking a mile at this rate, one would do work equivalent to lifting his body 400 feet vertically.

The amount of mechanical work done by a 200 pound man, then, walking a mile at the rate of three miles an hour, would be 80,000 foot pounds (400 x 200) equal to 80 calories.

At this rate, a man weighing 200 pounds would have to walk 8 or 9 hours, and to travel 25 to 30 miles in order to reduce his fat half a pound. The actual reduction in weight might be four times this, because of the water associated with solids in the tissues, although the water loss often follows a little later.

Automatic exercise, first employed by the author by means of the sinusoidal, electrical current some thirty years ago, has proved itself to be efficient as a means of reducing weight. When vigorously applied, this exercise may increase the energy output of the body to eight times the ordinary rate. The actual loss of weight in a half hour by automatic exercise sometimes amounts to as much as two pounds, but of course this great loss in weight is chiefly due to excessive perspiration, and does not represent actual fat reduction.

The rational method of dealing with cases of obesity requires the combination of exercise and diet restriction, the last being most efficient.

In cases of obesity due to disturbance of the internal secretions, an entirely different course must be pursued. The patient's increase of weight is not due to an excessive intake of food or fuel, but to diminished vital combustions. The fuel-food is not consumed as rapidly as it should be and hence accumulates, producing much the same effect as would result from an excessive intake of food. A metabolism test will probably reveal this condition when present. The metabolism rate is diminished.

The obesity resulting from disturbed metabolism is likely to be regional in character. The principal seats of accumulation are the abdomen, the hips, shoulders or breasts. Obesity from disturbed internal secretions is the most common form of over-fatness encountered in boys and girls. It makes its appearance before puberty, and in well pronounced cases there is marked delay in the development of the genital organs.

By proper tests, it may be shown that in these cases there is a diminished metabolism. The treatment consists not in greatly restricted diet and exercise but in the administration of preparations of the thyroid, pituitary or other internal glands.

Still another form of obesity may be mentioned which is sometimes termed anemic obesity. The patient is pale, the tissues are soft and flabby and contain an excess of water. The patient may be said to be "water-logged." Metabolism is deficient. These cases recover rapidly under the influence of tonic baths combined with light baths and massage. The diet should be rich in food iron. This means that the patient should eat a liberal serving of greens of some sort twice a day and should select for his bill of fare foods rich in iron (Table XII, p. 170).

In the dietetic management of obesity a few important points to be remembered are these: The protein intake should be not more than normal in amount. Fat may be almost wholly excluded from the dietary and the proteins and carbohydrates considerably reduced. If too great a reduction in the total food intake is made, the result will be loss of body protein, which is not desirable. Carbohydrates protect the body proteins more than do fats, hence they must not be too greatly reduced.

Greens should be used in abundance at every meal. A little butter taken at the beginning of the meal helps to cause a comfortable feeling of satiety.

Broths, such as bean broth, vegetable bouillon, and savora broth, should be freely used to supply vitamins.

A person undergoing treatment for the cure of obesity requires less water than a normal person under the same conditions for the reason that in the state in which they exist in the human body the solids are in biologic combination with a considerable amount of water. This water content of the tissues does not always leave the body as rapidly as do the solids in cases undergoing fat reduction. It is on this account that patients do not always lose in weight as rapidly as they are naturally expected to do, judging from the amount of the food intake and the elimination of solids taking place. When the elimination of water is slow it is only necessary to persevere in the application of the measures employed with the certainty that the effects desired will in due time make their appearance. Such cases are greatly benefited by the use of sweating baths and also by the disuse of salt.

Every over-fat person is a candidate for diabetes, a disease which when once well established, is rarely cured. On this account, it is important to discover the first symptoms early. The very first trace of sugar found in the urine should lead to a thorough reform of the habits of eating so that the disease may be checked at the outset. The intake of carbohydrates should be reduced to one-half or even one-fourth the usual amount. If the sugar does not at once disappear, a regular diabetic regimen should be adopted (p. 697). Every person, and especially every overfat person, should have an examination of the urine made on each birthday, so that any departure from normal conditions may have immediate attention.

DIABETES

In this disease, the patient has lost his power to burn the sugar which the blood takes up from the liver and so the kidneys must eliminate it to prevent the mischiefs which would necessarily arise from an accumulation of sugar in the blood. The primary fault is believed to be in nearly all cases in the pancreas, which normally creates and sends into the blood a substance which enables the muscles and other tissues to burn the blood sugar, but in diabetes fails to produce the necessary amount of hormones.

Sugar appears in the blood in an abnormal quantity before it can be detected in the urine by the ordinary tests.

In recent years, a new test known as the Bergel test has been developed by means of which the pre-diabetic state may be detected by examination of the urine; that is, a condition in which a moderate excess of sugar is found in the blood and in which carbohydrates are not well utilized.

The failure of the pancreas to produce the sugar-burning hormone is due to chronic pancreatitis, the cause of which is believed to be infection of the pancreas, which is associated with infection of the gall bladder and biliary passages.

Gall stones are frequently present in cases of diabetes, and in many cases recovery from diabetes has occurred when gall stones have been removed. In other cases, a cure has been affected by draining of the gall bladder.

The X-ray study of a number of diabetic cases made by Dr. James T. Case, showed that ileac stasis, that is, stagnation of the contents of the small intestine, exists in nearly all cases of this disease. This condition is produced in most cases, at least, by incompetency of the ileocecal valve, which is, in turn, due to dilatation of the cecum, an obstruction to bowel movement usually existing in the descending or pelvic colon. Infection gradually travels up from the lower bowel until it reaches the pancreas. Diabetes is only one of the disorders which may be due to this chronic intestinal toxemia.

In the dietetic treatment of this disorder, it is important to give consideration to the cause of the disease as well as to its results. The moderate suppression of sugar in the urine is by no means sufficient. The urinary sugar is merely a symptom of the disease. The most important thing of all is to check the progressive disease of the pancreas; in other words, to suppress the intestinal infection. This requires first of all relief of the intestinal stasis, which usually begins in the lower part of the bowel and gradually ascends until the small intestine becomes involved.

Chronic colitis, a spastic condition of the colon, stasis in the cecum, and any other conditions found present by careful examination, must be removed so far as possible by proper treatment.

The colon must be kept emptied by securing three full evacuations of the bowels daily. Agar-agar, specially prepared bran from which the starch has been removed, and paraffin oil are of essential service in accomplishing this end. If necessary, the warm water enema should be used once or twice daily, to secure thorough evacuation of the colon.

A strictly antitoxic diet must be adopted. This requires the elimination of meats of all sorts.

The next step is to arrange for the patient a bill of fare which will cause the disappearance of sugar from the urine and reduce the blood sugar. The amount of sugar normally found present in the blood is 9 to 12 parts in 1000. This may be increased in diabetes to two or three times the normal amount. The determination of urinary sugar is much more easily accomplished than that of the blood and it is a convenient means of watching the daily progress of the case. From time to time the urinary examinations should be supplemented by an examination of the blood.

More than twenty years ago, an important discovery was made by Guelpa, of Paris, who noted that when a diabetic patient was made to fast for a few days the sugar disappeared from the urine, even though present in considerable amount.

The subject has been further studied by Allen, Joslin and others in this country, as well as by the writer and his colleagues of the Battle Creek Sanitarium, and as the result a method has been developed by means of which it is possible to deal with cases of diabetes in a manner more satisfactorily than was possible in former times.

In mild cases of diabetes, the urine can be freed from sugar by fasting two or three days, and by proper regulation of the diet may be kept free. Cases are rare, in fact, in which by sufficiently careful management, the urine cannot be kept free from sugar.

Sakaguchi, who has made an extended research in relation to the effects of food on sugar elimination in diabetes, has shown that tolerance for carbohydrates is least at breakfast, and the elimination of sugar highest after the first meal of the day. He thinks this is due to the lessened production of glycogen in connection with the breakfast. He finds that the elimination of sugar following breakfast may be reduced by giving a small amount of carbohydrate an hour or two before breakfast.

It is also noted that carbohydrates are best burned if taken four or five hours after the preceding meal. If the interval between meals is prolonged to six hours or more, sugar elimination is increased.

The same investigator has observed that the sugar content of the blood is increased after eating, and that the maximum increase occurs two to four hours after the meal is eaten.

R. T. Williamson (*British Medical Journal,* February 2, 1918) lays great emphasis upon three general factors which seem to play an important rôle, at least as pre-disposing causes, in the production of diabetes mellitus. These are: habitual consumption of sugar and sweets; prolonged and intense mental anxiety, worry, overstrain, or sudden shock; a family history of diabetics.

Dr. Magnus-Levy, who has made a study of conditions in Germany since the war, reports that diabetes has practically disappeared, doubtless one of the many beneficent results following from the food restriction made necessary by the war.

The following account of the method of feeding diabetic patients in use at the Battle Creek Sanitarium, is summarized from a work by the writer, entitled *"The New Method in Diabetes."* *

The Fast.

If the urine contains a large amount of sugar, say 60 grams or more in twenty-four hours, or if sugar appears in spite of the fact that very little carbohydrate is taken in the food, the patient is required to fast for two or three days, or in certain cases even longer. The length of the fast will be determined by the disappearance of sugar from the urine. The fast is usually continued twelve or twenty-four hours after the sugar disappears.

During the fast, the patient should remain quiet in bed, or lying on a couch in the open air. He should drink three or four quarts of liquid daily (vegetable bouillon, water, or water flavored with some acid fruit, or savora broth).

The patient also takes one or two tablespoonfuls of starch-free bran or half an ounce of agar-agar four times a day, at four-hour intervals. An ounce of paraffin oil is taken with the bran. The purpose of this is to keep the bowels active. Specially prepared bran from which the starch has been removed is used for this purpose; simply washing the bran does not remove the starch. An enema should be taken daily.

If sugar reappears in the urine at any subsequent time, the patient is asked to fast again for one or two days or until the sugar disappears. If the amount of sugar is very small, restriction of the diet to green vegetables for a day or two will suffice instead of fasting.

The Semi-Fast.

It is found to be advantageous in most cases for the patient to take what may be termed a semi-fast once a week. Instead of his usual diet, the patient takes only green vegetables, which furnish bulk and very little nutritive material. Vegetables containing only two to five per cent of carbohydrate are used for this purpose. Elsewhere (p. 701) will be found a list of foods classified according to the amount of carbohydrate which they contain. Starch-free bran or agar-agar should be used freely on these days. One or two tablespoonfuls should be taken at each meal. The bran supplies not only bulk to encourage bowel action but also iron, lime and other salts which are highly valuable for the diabetic because of the constant loss of these salts, which is especially great in diabetes on account of the large discharge of urine. Bran also supplies useful vitamins.

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* Modern Medicine Publishing Company, Battle Creek, Michigan.

The patient should take an ounce of paraffin oil with each meal to insure free bowel action. Restriction of the quantity of food naturally leads to constipation unless these special precautions are taken to avoid it. Constipation increases the danger from acidosis and hinders improvement.

To Increase the Carbohydrate Tolerance.

Experience has shown that short fasts, repeated at intervals of a week or two, increase the tolerance for carbohydrate so that the starch content of the diet may be by this means gradually increased.

The Low Protein Ration in Diabetes.

Carbohydrate tolerance is found to be greatly increased by the disuse of meats. Von Noorden found that without meat five times as much starch could be taken without increasing the sugar of the urine as when meat was used with the starch.

After Sydenham and Rollo discovered, something more than a hundred years ago, that the urine of the diabetic patient could be made sugar free by a diet consisting exclusively of lean meat and fat, a fat and protein diet consisting almost wholly of flesh foods came into general use and has been practically the routine method until very recent years. A few years ago it was pointed out by Mosse, of France, and others, that a flesh diet greatly increases the danger of diabetic coma. Von Noorden announced several years ago that "much meat is not good for diabetics." Straub and other eminent authorities have shown that "meat is especially harmful as compared with vegetable albumin," such as gluten, and the protein of peas and beans. Reach believes that "raw (rare cooked) meat has a toxic action which paralyzes the function of the pancreas," and in this way exercises an injurious effect in diabetes.

Practically all authorities on diabetes now agree that vegetable albumin or protein is much to be preferred to meat or animal protein in the treatment of this disease. That vegetable proteins are entirely sufficient to maintain health and strength is now conceded by the ablest physiologists (see p. 31).

The advantages of a non-flesh dietary for diabetics are:

1. Vegetable proteins may be used in larger quantity than animal proteins without increasing the urinary sugar.
2. Vegetable proteins permit a larger carbohydrate intake.
3. Vegetable proteins, being less putrescible than animal proteins, as pointed out by Tissier, do not encourage intestinal putrefaction as do animal proteins, and hence are useful in combating the intestinal toxemia which is probably a leading factor in the causation of diabetes.
4. The danger from acidosis and diabetic coma is less.

The Best Food for Diabetics.

Nuts. The high fat and protein content and the very small proportion of carbohydrates present in most nuts render them almost ideal food for diabetics. Butternuts, for example, contain only two percent of carbohydrate, estimated on total energy value, and Brazil nuts only four per cent. Nuts of almost any sort may be freely eaten by the average diabetic patient They are not, of course, suited for an exclusive dietary as they are much too concentrated, being almost wholly lacking in the cellulose essential for bulk. The one thing essential for the thorough digestibility of nuts is complete mastication. Each particle must be chewed until of a smooth, creamy consistency.

Legumes. These highly nitrogenous vegetables find a useful place in the dietary of the diabetic when combined with a proper amount of fat. Peas, beans, and lentils have a high food content of which nearly one-third is protein.

The soy bean is a remarkable legume, the carbohydrates of which are lactans, and not digestible, and so may be disregarded. This bean is nearly free from starch and is very rich in protein of high quality.

Green Vegetables. Green vegetables must always constitute the bulk of the bill of fare of a diabetic patient. Green vegetables furnish a liberal supply of alkaline salts which help to neutralize the acids which form in the tissues in excess in this disease. Green vegetables are also of special service because they supply bulk with practically no starch and very little food value and are rich in food lime and iron and also vitamins.

Graduated Feeding.

After the fast, a carefully graduated diet is arranged by the physician or the trained dietitian. The amount of food taken must, of course, depend upon the patient's weight. A large person requires more food than a small person. In a mild case of diabetes in which the urine becomes sugar free on a diet consisting of about one-fourth the ordinary intake of starch, the amount of food may be increased more rapidly from day to day than in cases in which a complete fast, or even a second fast, is required to make the urine sugar free. On this account, three schedules have been prepared. Schedule 1 for mild cases, Schedule II for more severe cases, and Schedule III for those cases which require a strictly carbohydrate-free diet for a limited period.

Graduated Diet Schedule.

It is to be understood, of course, that these schedules are not to be employed in an arbitrary way. Slight modifications must be made to meet individual cases. The schedule, however, will serve to illustrate the method employed and will, at least, furnish an outline which will assist in the carrying out of a definite graduated plan. In most cases, the graduated scheme may be pretty closely followed, the figures being increased or diminished as may be necessary to adapt the schedule to the individual's weight, which is necessary since the patient's weight, or rather the standard weight for a person of the patient's height, is taken as the basis for calculating the quantities given in the schedule.

The following of a schedule thus adapted to each individual case, will certainly be found a considerable improvement over the old method which recognized no difference in the intake required by individual patients whose weight might vary as much as one hundred pounds or even more.

GRADUATED DIET SCHEDULE NO. 1.

The following is to be used in cases which become sugar free on the initial diet which is identical with the diet indicated for the first day.

Energy intake calculated for body weight of 130 pounds (59 kilos).

	Carbohydrate		Protein		Fats		Total		
Day	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal. per kil.
1	65	.5	195	1.5	260	2.0	520	4.0	8.8
2	130	1.0	195	1.5	390	3.0	715	5.5	12.1

	Carbohydrate		Protein		Fat		Total		
Day	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal	Cal. per. pound	Gal. per kil
3	195	1.5	195	1.5	520	4.0	910	7.0	15.4
4	260	2.0	195	1.5	650	5.0	1105	8.5	18.7
5	325	2.5	115	1.5	780	6.0	1300	10.0	22.0
6	338	2.6	195	1.5	845	6.5	1378	10.6	22.3
7	351	2.7	195	1.5	910	7.0	1465	11.2	24.6
8	364	2.8	195	1.5	975	7.5	1534	11.8	26.0
9	3(7	2.9	195	1.5	1040	8.0	1612	12.4	27.3
10	390	3.0	195	1.5	1105	8.5	1690	13.0	28.6
11	416	3.2	195	1.5	1170	9.0	1781	13.7	30.0
12	442	3.4	195	1.5	1235	9.5	1872	14.4	31.7
13	468	3.6	195	1.5	1300	10.0	1963	15.1	33.2
14	494	3.8	195	1.5	1300	10.0	1989	15.3	33.7
15	520	4.0	195	1.5	1300	10.0	2015	15.5	34.1
Work ration—									
	650	5.0	195	1.5	1560	12.0	2405	18.0	39.6

GRADUATED DIET SCHEDULE No. 2

The following schedule is to be used for patients who do not become sugar free until after two or three days of liquid diet or fasting.

Daily energy intake calculated for a body weight of 130 lbs. (59 kilos).

	Carbohydrate		Protein		Fat		Total		
Day	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal.	Cal. per pound	Cal. per kil.
1	65	.5	65	.50	130	1.0	260	2.0	4.4
2	81	.62	97	.75	260	2.0	458	3.37	7.8
3	97	.75	130	1.00	390	3.0	617	4.75	10.5
4	113	.87	162	1.25	520	4.0	795	6.12	13.5
5	130	1.00	195	1.50	650	5.0	975	7.50	16.5
6	130	1.00	195	1.50	715	5.5	1040	8.00	17.6
7	130	1.00	195	1.50	780	6.0	1105	8.50	18.7
8	130	1.00	195	1.50	845	6.5	1170	9.00	19.8
9	130	1.00	195	1.50	910	7.0	1235	9.50	20.9
10	130	1.00	195	1.50	975	7.5	1300	10.00	22.0
11	130	1.00	195	1.50	1040	8.0	1365	10.50	23.1
12	130	1.00	195	1.50	1105	8.5	1430	11.00	24.2
13	130	1.00	195	1.50	1170	9.0	1495	11.50	25.3
14	130	1.00	195	1.50	1235	9.5	1560	12.00	26.4
15	130	1.00	195	1.50	1300	10.00	1625	12.50	27.5
16	130	1.00	195	1.50	1365	10.50	1690	13.00	28.6
17	130	1.00	195	1.50	1430	11.00	1755	13.50	29.7
18	130	1.00	195	1.50	1495	11.50	1820	14.00	30.8

GRADUATED DIET SCHEDULE No. 3.

To be used in cases in which a carbohydrate-free diet is needed for several days.

Calculated for a body weight of 70 lbs. (59 kilos.)

	Protein		Fats			
Day	Cals.	Cals. per pound	Cals.	Cals. per pound	Total Cals.	Total Cals. per lb. body wt.
1	65	.5	260	2.0	325	2.5
2	78	.6	325	2.5	403	3.1
3	91	.7	390	3.0	481	3.7
4	104	.8	455	3.5	559	4.3
5	130	1.0	520	4.0	650	5.0
6	143	1.1	585	4.5	728	5.6
7	156	1.2	650	5.0	806	6.2
8	169	1.3	715	5.5	884	6.8
9	182	1.4	780	6.0	962	7.4
10	195	1.5	845	6.5	1040	8.0
11	208	1.6	910	7.0	1118	8.6
12	221	1.7	975	7.5	1196	9.2
13	234	1.8	1105	8.0	1274	9.8
14	247	1.9	1235	9.0	1417	10.9
15	260	2.0	1365	7.0	1560	12.0

Use of the Schedules.

In the use of the schedules it is only necessary to remember that the tables are adapted to the needs of a person having a normal weight of 130 pounds. (See table showing normal weights for different heights, (p. 100). For a person whose proper weight is ten per cent. less, 117 pounds, subtract ten per cent. from the quantities named in the table. A person having a weight greater than 130 pounds should increase the quantities given in the schedule as may be required to make the "per pound" ration equal that shown in the schedules.

Table Showing Amount of Carbohydrate Calories per Ounce in Some Common Foods.

NUTS

Almonds	20.0
Beechnuts	15.0
Butternuts	4.0
Brazil nuts	8.0
Filberts	15.0
Hickory nuts	13.0
Pecans	18.0
Pine nuts	24.0
English walnuts	18.0
Peanuts	28.0
Peanut meal	12.8

VEGETABLES

Spinach	3.9
Asparagus	3.5
Cauliflower	7.0
Cabbage	9.0
Celery	5.3
Lettuce	5.6
Beet greens	3.7
Turnip greens	8.0
Dandelion greens	12.0
String beans	8.6
Salsify	4.1
Turnips	3.5
Egg plant	6.0
Palm cabbage (heart palm)	4.0
Lily root	Trace
Lily flower	Trace
Bamboo shoots	1.0
Soy bean	8.5
Bean stick	.0

CEREALS

Pure gluten biscuit	5.0
40% Gluten biscuit	56.0
Soy biscuit	5.0
Diabetes bran	0.0

FRUITS

Bananas	25.7
Apples	16.6
Sour Apple juice	17.0
Apricots	15.6
Blackberries	12.7
Blueberries	19.0
Cantaloup	10.9
Grape fruit	11.8
Grapes	16.6
Orange pulp	13.5
Orange juice	15.1
Peaches	11.6
Raspberries	14.7
Strawberries	8.6
Tomatoes	4.6
Avocadoes	4.6

Diabetic Green Diet.

BREAKFAST

Savora broth
¼ oz. diabetic bran
4 oz. tomatoes
2 oz. lettuce
Minute Brew—1 tablespoon cream
Unsweetened vegetable gelatine
3 oz. asparagus

DINNER

Tomato broth with Savita
¼ oz. mixed bran
3 oz. string beans
3 oz. celery
2 oz. endive
Kaffir tea and lemon
Unsweetened vegetable gelatine

SUPPER

String bean broth
¼ oz. mixed bran
3 oz. cabbage
3 oz. spinach
Minute Brew and 1 tablespoon cream
Unsweetened vegetable gelatine
2 oz. cucumbers

(To be used every ten days or when sugar shows in urine)

Foods to be Wholly Avoided by Diabetics.

Sugar
Sweet desserts
Sweet fruits
Honey
Tea and coffee
Potatoes (unless prescribed)
Alcoholic drinks
Meats (fish, flesh, fowl)
Chestnuts
Breakfast cereals
White flour breads and rice
Pickles, vinegar condiments

Foods Containing a Moderate Amount of Carbohydrates.

The following foods may be used in great moderation by patients whose carbohydrate tolerance permits the use of 400 or 500 calories of carbohydrate daily:

Rye bread
Bran bread
Sour apples
Oranges
Peaches
Apricots
Grapefruit
Protose
Nuttolene
Buttermilk
Strawberries
Sour cherries
Peanuts
Soy beans
Nuts of all sorts
Bamboo shoots
Palm cabbage
Asparagus
Turnips
Cabbage
Rutabaga
Huckleberries

Foods Practically Free from Carbohydrates.

Butter (sterilized or washed)
Olive oil
Butternuts
Brazil nuts
Lettuce
Celery
Cucumber
Radish
Lily root
Spinach
Tomatoes
To fu
Lily flower
Nut oils
Pure gluten biscuit
Extracted vegetables
Eggs
Dandelion greens
Turnip tops
Beet tops
Endive
Asparagus
Water cress
Soy bean sprouts

To Remove Starch from Vegetables.

Green vegetables contain very little starch and only a small amount of dextrine and sugar. By repeated boiling or soaking in warm water nearly all the carbohydrates present may be removed. When thus treated, the vegetables are said to be "extracted." It is very difficult, however, to remove the very last trace of carbohydrates, although O'Reilly and McCabe have shown that lettuce, celery, and vegetable marrow may be made completely free from carbohydrates by thrice boiling. For best results it is necessary that the vegetables be boiled in twenty times their volume of water. Canned spinach, canned asparagus, beets, onions, and turnips may be made nearly free from carbohydrate, while thrice-boiled cauliflower, pumpkin, cabbage, carrots, and string beans contain about one-half of one per cent. of carbohydrate. The addition of one-twentieth of one per cent. of bicarbonate of soda greatly favors the removal of the carbohydrate, especially in the case of cauliflower. The following methods have been found satisfactory in practice.

Wrap the finely sliced vegetables in double cheese cloth and soak in cold water for 30 minutes. Pour off the water and add to the vegetables twice their weight of cold water. Heat to boiling and continue boiling for 5 minutes. Pour off the water. Add fresh water and repeat the boiling for 5 minutes. Repeat. All vegetables should be boiled at least three times to make them starch free. Asparagus requires four or five boilings.

After wrapping the finely sliced vegetables in double cheese cloth, soak in double the weight of water at 140° F. for 15 minutes. Drain the water off and repeat the soaking in warm water several times. After three or four soakings, test the water with Fehling's solution for the presence of sugar, after adding a little acid and boiling. Repeat soakings until the test is negative.

The following vegetables prepared by thrice boiling contain about one calory of carbohydrate per ounce, a quantity so small that it may be ignored except in the gravest cases:

Turnips
Parsnips
Palm cabbage
Beets
Summer squash
Carrots
Vegetable oysters
French artichokes
Rutabagas
Onions
Egg plant
Cabbage

Examination of the Urine.

Diabetic patients should learn to examine the urine for sugar and dangerous acids. If the tests show sugar or acids, even a trace, the diet must be changed at once. A fast day, or even a green vegetable day, will usually suffice to cause the sugar to disappear. When a trace of sugar still persists, a second or even a third day of fasting may be necessary. Then the diet must begin at a lower level, say one-third the former amount of carbohydrate, and if the acid test is very pronounced, two-thirds the former amount of fat; then gradually increase the amount of starch and fat from day to day, stopping a little short of the amount of carbohydrate or of fat which caused the sugar or acid to appear. After some time, a week or two, another attempt may be made to increase the amount of carbohydrate or fat. This increase should follow a green diet day.

For method of urine examination see (p. 525).

Saccharine.

The use of saccharine by diabetics should be discouraged. The diabetic should be educated to forget sweets and to be contented without them. A few weeks of discipline will accomplish this. Heitler, of Vienna, has shown that saccharine is a heart poison. Under its influence, the heart's action is lessened in vigor, and its continued use may give rise to serious injury.

Recipe for Gluten Bread.

Make a rather stiff dough by adding to the best quality of spring wheat flour the proper amount of water. Allow to stand for two or three hours, then knead until a strong, elastic, tenacious dough is formed. Now place on a sieve or coarse cloth under a spigot and knead under a small stream of water until no more starch can be washed away; that is, until the water runs away clear. The rubber like mass left is almost pure gluten. This may be molded and cut into small masses and baked in a quick oven. Surprisingly large rolls may be made from very small pieces of this wet gluten. If 40 per cent gluten is desired instead of merely pure gluten biscuit, flour may be added to the gluten in right proportion to produce the desired percentage. In general, about one pound and a quarter of spring wheat flour will be required for each pound of wet gluten. Gluten bread is more easily made by the use of 40% Gluten Flour.

Gluten biscuit are especially useful in the feeding of diabetic patients. Gluten bread contains more lime and iron than any other food product. A pure gluten biscuit weighing one-half ounce contains as much protein as a small beefsteak weighing two ounces, besides more iron and lime.

Recipe for Nut Cakes.

Half an ounce of yeast, 2 tablespoonfuls of lukewarm water, 8 ounces of almond meal or peanut meal mixed into a paste, adding a little more lukewarm water if necessary. Leave in a warm place for one hour. Beat one egg with two tablespoonfuls of milk and a little salt and add this to the mixture, stirring well. Bake in small baking tins in a moderately hot oven for 20 or 30 minutes.

The same recipe may be used with different proportions of gluten flour.

DIET IN SIMPLE GOITER

In simple goiter there is diminished activity of the thyroid gland. The development of this disease appears, in some cases at least, to be connected with a deficiency of iodine. The disease especially affects girls, and sometimes appears in young animals. It is related that in the pioneer days of Michigan sheep raising was almost impossible on account of the death of animals from goiter. The use of salt containing a small amount of iodine was found to be a cure for the disease.

The great mortality of young pigs in many parts of the country, from the same cause, has been checked by the administration of small quantities of iodine. The normal thyroid gland contains about one-seventh of one grain of iodine. The normal daily intake of iodine is about one two-hundredth of a grain. The diseased thyroid often contains less than one twentieth the normal amount of iodine.

The diet should be made antitoxic, including liberal quantities of greens, and particularly the following foods, which analysis has shown to contain iodine in appreciable quantities: Turnips, melons, lettuce, beets, tomatoes, French beans, green peas, radishes.

The carrot, parsley and potato, also contain considerable quantities of iodine, while the cucumber, pumpkin, spinach and kidney beans contain only very small quantities.

It is quite possible that concentrated extracts prepared from such vegetables as the turnip, radish, French beans and beets, used daily in proper quantities, might be of substantial service in these cases.

Observations of Chalmers Watson suggest the special value of oatmeal in the feeding of persons suffering from simple goiter.

DIET IN HYPERTHYROIDISM—EXOPHTHALMIC GOITER

In this disease there is an excessive activity of the thyroid gland, a condition which is believed to be brought about by the influence of poisons circulating in the blood. There are several interesting experimental facts which have a strong bearing upon dietetic indications in this condition. In the early experiments for the purpose of studying the function of the thyroid gland, the gland was removed from dogs. It was noticed that these dogs soon became subject to convulsions and other grave disorders and after a few weeks died. It was later learned, however, that if the dogs were fed on bread and milk instead of meat, death did not occur. This led to the theory that a function of the thyroid gland is to destroy the poisons which develop in the body as a result of flesh eating.

That such poisons do develop has been well known since the classical experiments of Bouchard, who found that solutions prepared from the stools of meat eaters were twice as toxic as those prepared from the stools of non-flesh eaters. Herter, of New York, observed that animals were quickly killed by solutions prepared from the stools of carnivorous animals, but did not succumb to similar solutions prepared from the stools of herbivorous animals.

Numerous highly virulent poisons have been isolated from the stools of flesh eating men and carnivorous animals. The putrid character of the stools of carnivorous animals and meat-eating men is a clear indication of the abundance of poisonous putrefaction products found in such stools.

Extensive laboratory research has shown that the thyroid gland is actively concerned in the destruction of poisons circulating in the blood. The first line of defense against poisons is the intestinal mucous membrane. Next, the liver offers an important barrier against toxic invasion. The third line of defense is the thyroid gland and other glands of internal secretion which are associated with it.

In typical cases of hyperthyroidism the thyroid gland is enlarged and its activity enormously increased. A general disturbance of the body results from the abnormal increase of thyrotoxin or thyroidin which increases greatly the activity of the body cells, producing hypermetabolism, sometimes to the extent of even doubling the normal cell activity of the body. This increase affects especially, according to Plummer, the protein metabolism, which is also known to be increased in febrile conditions generally.

It may be said, then, that in exophthalmic goiter the body is suffering from an intense toxemia in which, in addition to poisons produced in the alimentary canal and perhaps elsewhere, the body is also disturbed by thyro-toxin produced by the thyroid gland itself.

It is evident, then, that in the dietetic treatment of exophthalmic goiter, or hyperthyroidism, it is of primary importance to suppress all foodstuffs calculated to increase the production of poisons in the body or which will tend to in any way stimulate the activity of the gland. That meats, meat extracts, bouillon, and broths are active stimulants of the thyroid gland is now generally recognized. Says Plummer of the Mayo Clinic: "Unquestionably the diet should be one that will reduce metabolism to the lowest point. This indication is best met by a diet low in proteins." Fish, shellfish, meats, tea, coffee, alcohol and tobacco are all well-known to be stimulants of the thyroid gland and their use must be positively prohibited. This practice the writer has followed for more than forty years, and by this method he succeeded in curing a considerable number of severe cases of exophthalmic goiter long before relief of this condition by operation was even suggested.

While there are still a few authors who recommend the use of meat in this disease, the ablest authorities, both English and American, recommend that meat should be wholly discarded and that the diet should consist of milk and farinaceous foods with fresh vegetables and fruits.

Chalmers Watson claims to have demonstrated that oatmeal also stimulates the thyroid and on this account this cereal is usually excluded from the dietary of patients suffering from

Graves' disease. It is difficult to understand how a simple cereal should behave in this manner, and the writer has never observed any injurious effect from the use of oatmeal. Nevertheless, until further light is obtained upon the subject, it will be well to avoid the use of oatmeal in more than small amounts in feeding these patients. Foodstuffs known to be rich in iodine should be used very sparingly or altogether discarded in this disease (p. 704).

The excessive activity of the body cells results in a rapid wasting of the tissues, a loss which must be met by an increase in the food intake. The basal metabolism of a person suffering from hyperthyroidism may, in extreme cases, be double the normal basal metabolism so that in addition to keeping the patient very quiet, an essential factor in treatment, there must be an increase in the total number of calories eaten. The proteins should not be increased, as this will still further increase the abnormal activity. The increase should be confined to the fats and carbohydrates, chiefly the latter.

In all cases operated upon for relief of exophthalmic goiter, the dietary above described should be strictly followed, and not simply as a temporary measure, but permanently. Otherwise the disorder is almost certain to recur, making another operation necessary.

Dr. George Murray, M. A., F. R. C. P., an eminent English physician, calls attention to the importance of a low protein diet in Grave's disease, or exophthalmic goiter, citing the observations of Chalmers Watson, who showed by experiments upon rats that the thyroid gland becomes diseased as a result of an exclusive meat diet.

HYPOTHYROIDISM

It is now generally conceded that the thyroid gland is the seat of iodine metabolism. This gland removes from the blood minute quantities of iodine and therewith produces its special secretion, thyroidin, which is in excess in hyperthyroidism but deficient in hypothyroidism, giving rise to certain well marked morbid conditions. Well marked hypothyroidism in children is known as cretinism and in adults or adolescents as myxedema. In this condition, there is a diminished activity of the body cells due to the lack of the stimulating influence of the thyroid secretion. The body cells are overburdened with waste products. This is clearly shown in the skin, which becomes puffy, dry and inactive. The whole body becomes sluggish, including the brain, and in young children, cretinism, a condition bordering on idiocy, is developed.

The myxedematous patient usually has a cachectic appearance suggesting Bright's disease. The speech is slow and sluggish, as though the tongue were swollen. The patient moves slowly and clumsily. There appears to be a mental as well as a physical slowness.

These patients generally have a tendency to increase in weight and are often large eaters. Care must be taken to restrict the amount of food to actual needs. A reducing diet (p. 601) for a week or two is advantageous at the outset of treatment.

Mild forms of hypothyroidism occur much more frequently than is generally recognized. This condition almost universally develops in advanced age and is indicated by dryness of the hair and skin and the development of a depression just above the sternum, the result of atrophy of the thyroid.

In this condition, the natural conclusion would be that a radically different dietary would be indicated and perhaps flesh meats might be admissible on account of their iodine content and their stimulating influence upon the thyroid.

But this is not the case. While oatmeal and vegetable foods containing iodine are especially indicated, meats of all kinds are certainly contraindicated for the reason that putrefaction of undigested remnants of flesh foods in the colon gives rise to toxic products with which the crippled thyroid is not prepared to deal, it being remembered that dogs whose thyroid glands have been removed, died when fed meat but lived with a diet of bread and milk. It is a well-known fact that in cases of myxedema, a meat diet will "sometimes induce tetanic attacks or convulsions." Flesh foods of all sorts must be wholly and permanently avoided.

Rosenbloom recommends a diet containing a minimum amount of protein. The low protein diet is necessary to lessen the intestinal putrefaction which enormously increases the work of the thyroid. Foods rich in iodin are useful because iodin is necessary to enable the thyroid to do its work.

Another point of essential importance in these cases is the feeding of thyroidin, thyroid extract or dried thyroid gland. This feature of the diet, however, should rather be classed as medication and should be carried on under the supervision of a competent physician, since it is quite possible to do harm as well as good. The good effects of thyroid feeding in most cases quickly become apparent. Much harm may result from overfeeding, which should be carefully avoided. It is a grave error, however, to depend exclusively upon thyroid feeding.

Regulation of the diet in such a way as to lessen the amount of poisons circulating in the blood, and thus diminishing the work required of the thyroid, is of first importance. This alone is sufficient to secure radical improvement even in grave cases of myxedema, although more rapid progress is made when careful dietetic management is combined with thyroid feeding.

Murray reported in 1920 the death of the first patient treated for myxedema by thyroid extract. The patient began treatment by this remedy in 1891 at the age of 46 years. She continued the treatment until her death in 1919 at the age of 74. Her life was doubtless greatly prolonged by the use of thyroid extract.

The great number of operations now-a-days being done for relief of exophthalmic goiter will, in the writer's opinion, produce an epidemic of surgical hypothyroidism a few years in the future. Operators not infrequently remove so much of the gland that not more than a fifth, or even a tenth of the original gland structure is left. When an operation of this sort is performed and no change is made in the patient's dietetic habits, overstimulation of the gland will continue and the small fraction of gland left will be overworked to a greater extent even than the whole gland would have been, although the unpleasant effects arising from the excessive production of thyroidin may not appear. Overwork of a gland always results sooner or later in degeneration and diminished functional activity. It is inevitable that these abbreviated thyroids should suffer a very great shortening of the duration of their functional activity.

To say that a man is as old as his thyroid is equally as true as to say that a man is as old as his arteries, for the thyroid function is an important link in the chain of vital activities which are essential to the prolongation of life.

Deficient functioning of the thyroid, or hypothyroidism, is one of the active factors in inducing the changes characteristic of senility, particularly the changes in the hair and the skin. When the skin becomes thin, dry, parchment-like, inelastic and covered with brown patches, the function of the thyroid gland is impaired. These external evidences of old age degeneration are only the outward sign of similar degenerative changes taking place all through the body, which are in part at least the result of the loss of the thyroid function. To live long and well, one must take good care of his thyroid and must keep it intact. To accomplish this it is necessary that the thyroid should not be overworked by the use of flesh meats and other toxin containing foodstuffs and by such neglect of the colon as will permit it to become an incubator of noxious germs and a veritable reservoir of virulent poisons.

In many forms of skin diseases, as well as in premature old age, hypothyroidism is found to be the dominant factor. In all these conditions the dietary suggestions made above may be followed with marked advantage.

Another of the consequences of thyroid inefficiency is an irritation of the skin which results from the chapping due to excessive dryness. This occurs especially in winter and gives rise to an irritation of the skin in old people known as "winter itch."

These conditions indicate the necessity for increased activity of the thyroid, which may be encouraged by the use of foods rich in iodine, and if necessary, by thyroid feeding.

In conclusion, attention must be called to the importance of maintaining a sanitary condition of the colon. This requires three bowel movements daily, or an emptying of the colon after each meal. To accomplish this, it is necessary that a much larger amount of roughage than that found in the ordinary bill of fare should be made a regular part of the dietary (see laxative diet, p. 580). Bran to the extent of a quarter ounce at each meal and an abundance of greens, are probably the best forms of roughage for regular use. Agar-agar may sometimes be employed advantageuosly, and the continuous use of mineral oil both before and after each meal is necessary to serve as a lubricant in cases in which constipation has existed so long that the natural lubricating function of the colon has been impaired.

The amount of thyroid needed is much less when a strict antitoxic diet is followed and the intestinal flora changed (p. 552) and kept free from putrefactive bacteria.

DYSPITUITARISM

In this disorder there is a remarkable tolerance for carbohydrates. This is not a morbid symptom but simply an instinctive or automatic indication of a special need. The craving for carbohydrates should be curbed only to such a degree as to prevent undue indulgence in confectionery and other sweets. If the patient is asked to avoid the use of candy and sugar, confining the indulgence in sweet things to sweet fruits and fruit juices, malt sugar and malted preparations, no harm will be likely to result from the gratification of the appetite for saccharine and farinaceous foods. Proteins should be kept at a low level. The appetite must be curbed in cases in which there is a marked tendency to accumulation of fat, and the intake of butter and other oleaginous foods may be reduced to a minimum. Potatoes should be largely used instead of cereal foods. This is advantageous, first, because they are more bulky and hence will diminish the tendency to over-eating, and second, because potatoes, like other farinaceous roots, are rich in organic bases which are needed to neutralize the acid wastes with which the body is likely to be overcharged. Potatoes are also richer in iodine than are cereals.

Special attention must be given to the colon and to the intestinal flora, which always needs to be changed, so as to lighten so far as possible the burden upon the crippled thyroid, which is one of the most important poison-destroying glands of the body.

The bowels must be kept active, at least three movements a day, by a laxative diet (p. 580) and the use of bran, agar, and mineral oil. The flora must be changed.

The same principles of treatment apply as in disease of the thyroid. Evidence of pituitary deficiency requires the administration of the dried gland in connection with proper diet. Thyroid deficiency may exist at the same time, in which case, feeding may also be found necessary. The regulation of the dose of thyroid or pituitary gland substance requires the attention of a physician skilled in this particular class of ailments.

ADDISON'S DISEASE

While little can be accomplished either by diet or other means in this disease, in the direction of a cure, much can be done to better the patient's condition and prolong life by careful regulation of the diet. The essential things to be done are to change the intestinal flora and then to suppress intestinal putrefactions by an antitoxic diet. Meats of all sorts must be excluded. The bowels must be kept active by a laxative diet, supplemented by daily enemas. Carbohydrates may be freely used with advantage. In some cases, benefit has seemed to follow the use of liberal doses of dried adrenal gland.

The patient is always toxic, and hence the flora must be changed by the fruit regimen with milk sugar and the lactic acid ferment, *B. Acidophilus* (Acidophilus-Lactose).

UREMIA

The diet in uremia should be the same as indicated for acidosis (p. 719). It should consist exclusively of fruit juices and such carbohydrates as malt sugar and raisin water (pages 148 and 663). Malt sugar is superior to the juice of raisins in these cases, for the reason that the latter contains some tartaric acid, which is less perfectly oxidized in the body than is citric acid and may tend to increase the acidosis. Orange juice is of great value in these cases and may be freely used with advantage in cases of renal acidosis as well as in acidosis due to defective metabolism, the so-called ketonic acidosis. Protein should be wholly excluded from the diet for a few days.

Enemas containing two ounces of malt sugar to the pint may be given in quantities of half a pint to a pint every hour to be retained. The colon should be emptied by a large enema every four or five hours.

THE ANEMIAS

In anemia, there is a notable lack of iron and of blood cells. The problem is to supply the body with the iron needed for the production of new red blood cells, and to encourage the blood-making process. It is now generally recognized that this can be best accomplished only through the means of appropriate foodstuffs and the application of other natural curative measures and not by the use of drugs. Neither is feeding alone sufficient. Out-of-door air, in proper cases exercise, sunlight, cold bathing, and attention to all health-promoting measures, are almost equally important.

The diet, in addition to a sufficient amount of food iron.

must also present to the body an abundance of vitamins, lime, complete proteins and other essential tissue-building elements. Hence, the restorative regimen is required (p. 588), especial care being taken to include foods rich in iron in sufficient quantity to double the ordinary normal intake of iron. The ordinary amount of iron excreted by the body daily is about one-sixth of one grain. Since the total amount eaten is never assimilated, it is necessary that the daily intake or the food iron ration should be about one-fourth of a grain. The amount of each one of the ordinary foodstuffs which contains this quantity of iron, is given in the table shown elsewhere in this work (p. 165).

Anemia is coming to be very widespread in this country because of the neglect of the use of green stuffs which in every other country are extensively employed.

An explorer for the United States Bureau of Plant Introduction informed the writer that the average Chinaman eats four times as much greens as does the average American. When it is realized that it is from greens that our supply of iron is chiefly derived, it becomes apparent that the national anemia must be the consequence of this serious dietetic neglect. Every effort should be made to instruct the public with reference to this grave error, which is almost universal in this country.

The one-fifth to one-fourth of a grain of iron necessary to make good the daily loss represents about one two-hundredth part of the total iron content of the body.

Each drop of one per cent in the hemoglobin content of the blood means a loss of .43 grains of iron. A loss of 20 per cent, as in a case showing a hemoglobin content of 80 per cent, means a deficiency of 8.6 grains, the amount of iron found in thirty-four pounds of spinach.

By eating half a pound of spinach a day, this amount of iron might be absorbed in sixty-eight days, or a little more than two months. It must be remembered, also, that the bill of fare must be so constructed as to supply the patient in addition his full normal daily ration of iron, which may be easily done by the aid of the table above referred to.

In cases in which anemia is due to loss of blood, the iron of the body may be quickly restored by proper feeding, provided there is no recurrence of hemorrhage. The same is true of all secondary forms of anemia. When the cause is removed, proper feeding will quickly restore the patient.

An important point to which attention should be especially called is the fact that flesh foods are not especially valuable for building up the blood. The popular idea that red meat of some sort is indicated in anemia has no sound scientific basis. Red meats often have been prescribed as a remedy for anemia with most unsatisfactory results. More than forty years ago, when the writer was a young practitioner, the drinking of blood was for a time almost a fad with persons suffering from anemia. Prominent physicians regularly recommended their patients to visit city abattoirs to drink blood warm from the cut throats of slaughtered animals. The results were altogether disappointing. Although red meats and blood are rich in hemoglobin, it appears that the iron of hemoglobin is not so readily assimilated as is iron in the form in which it is furnished in plants, particularly green leaves (Sherman).

Grigoriew has shown that rabbits rendered anemic by bleeding improve much more rapidly when given chlorophyll, or organic iron found in green leaves, than when given iron in a metallic state.

Attention should also be called to the fact that there are many vegetable foodstuffs which are far richer in iron than is lean beef, while the fat of meat contains no iron at all. For example the following common foodstuffs (20 in number) are all richer in iron than is beefsteak, namely: almonds, barley, beans, egg yolk, hazel nuts, molasses, malted nuts, malt sugar, peas, protose, 40 per cent gluten flour, gluten purée, rye, entire wheat, wheat bran, figs, dates, prunes, mustard greens and many other green stuffs. A few vegetable foods contain nearly double the amount of iron contained in beefsteak, among which may be mentioned lima beans, lentils and wheat bran. And it must not be forgotten that the iron found in these vegetable products is more easily assimilated than that found in meats.

Even that humble vegetable, the onion, contains a notable amount of iron which is said to be of particularly fine quality; while the yolk of egg contains as much iron as more than twice its weight of the best beefsteak.

Savita, an extract of yeast, is still richer in iron, containing thirty-seven times as much iron as does an equal weight of the best beefsteak.

A person suffering from chronic anemia must make radical changes in his bill of fare. Meats must be discarded. Nuts, nut meats, and glutens should take the place of meats. Foods rich in iron should be the staples of each meal. Cane sugar should be replaced by malt sugar, dates, figs and raisins. Malted Nuts (vegetable milk) is rich in iron and may well in part replace milk, which is very poor in iron (See pp. 167, 350, 418). Lentil soup and greens of all sorts must enter largely into the dietary. Flesh-meats are never needed.

A cup of Savita (savora) broth contains as much iron as half a pound of beefsteak besides food lime and vitamins and highly palatable osmazome.

Much more interesting and useful data respecting the iron content of foods may be obtained by a careful study of the table (pp. 165, 170).

Pernicious Anemia.

In *pernicious anemia, leukemia, Addison's disease,* and other of the grave forms of anemia, the problem is by no means so simple as in ordinary anemia. In these cases, there is undoubtedly a profound toxemia, the seat of which in many cases at least, is the intestinal canal, as shown by the highly putrid character of the stools.

On this account, it is of the utmost importance to give attention to the alimentary canal and to suppress foodstuffs calculated to promote intestinal putrefactions.

The failure of the gastric glands to produce hydrochloric acid, a condition present in most cases of pernicious anemia, deprives the intestinal tract of the normal disinfectant action of the gastric juice. In such cases, putrefactive bacteria taken with the food are not destroyed in the stomach but are left to grow and thrive in the intestine, especially in the colon, exposing the body to the pernicious influence of a great variety of putrefaction products. Some of these products destroy the red blood cells when brought in contact with them, a fact which was believed by Herter to explain the disappearance of the red blood cells in pernicious anemia.

Fortunately, greens, which are absolutely essential in the feeding of anemic patients, are among the most laxative of foodstuffs. These must be freely used and also bran, which should be eaten to the extent of one ounce daily, or at least a large tablespoonful at each meal.

When taken by itself, bran is rejected by the nerves of the throat, which recognize it as foreign material rather than food; hence the bran must be mixed with a considerable quantity of food to conceal its innutritious character and provoke the normal swallowing reflex. A couple of tablespoonfuls of bran may be easily concealed in an ordinary dish of breakfast cereal. With the addition of malt sugar or malt syrup, and a little cream, such a mixture is not at all unpalatable.

Bran may also be added to potato and other purées and thick soups of all sorts or it may be eaten with bread and milk. It is necessary to insist that it should be taken at every meal.

Fortunately, bran is also rich in iron. An ounce of bran contains .034 grains of iron, and the daily dose of one ounce of bran would thus contribute a sufficient amount of iron to lessen the required intake of spinach by two ounces.

By reference to the table (p. 285), it will be seen that some other greens, particularly the narrow-leaved dock and red root, contain double the amount of iron found in spinach.

As before remarked, it is idle to rely upon drugs,—iron. arsenic, or other drugs, for the cure of anemia. Blood corpuscles cannot be made without food iron. Arsenic and iron combined may sometimes render some service in the treatment of anemias by stimulating the blood-making processes, but such stimulation is unnatural and the results are altogether disappointing when these methods are relied upon, for no substantial progress toward actual cure can be accomplished without supplying the body with the normal material required for the construction of blood cells; that is, hematogen, or food iron, which is alone produced by the vegetable kingdom.

The apparent benefit often secured by the use of arsenical preparations, such as cacodylate of soda, has led to the widespread use of these remedies to the neglect of proper feeding. That this practice is a great error, however, has been pointed out by Chaippori, who found (*Riforma Medica*) that in the administration of arsenic in cases of anemia there is an increase of red corpuscles, but no increase of white cells. In one case the red cells were found to be increased one million within an hour after injection. The increase in the red cells was found to be due to the throwing into the circulation of a great number of young and immature red cells. These young cells possess so little resistance that they were quickly destroyed and eliminated, as shown by an increase of urobilin in the urine. Poggi confirmed these observations, which clearly show the futility of depending upon arsenic to cure anemia. The taking of more food iron in the food, relief of autointoxication and the proper use of exercise, phototherapy, and cold frictions with other forms of hydrotherapy, are the most efficient means of combating anemia. If iron or arsenic is sometimes useful in stimulating the blood making processes, food iron must supply the raw material for producing new hemoglobin. Drugs cannot be relied upon to restore the blood or any other wasted tissue. The use of ox blood and preparations of blood in severe anemia, once so common, has no scientific foundation.

If blood were readily available for replenishing the wasting iron stores of the body, carnivorous animals would never suffer from anemia, and vegetable eating animals would be especially subject to blood impoverishment; but the very opposite is the case. Carnivorous animals are far more subject to anemia than are herbivorous or grass-eating animals (Sherman). And where does the ox find iron for making his rich red blood if not in the green grass on which he feeds? It seems that "original sources" are of as much consequence in the matter of iron supply as in so many other of our every day affairs.

If the iron of blood and flesh was a superior source of iron for replenishing the iron losses of the body, such losses would not occur except as the result of hemorrhage from accident or other cause. This is evident from the fact that the waste iron is excreted through the intestine. If such iron as is supplied by beefsteaks or by the chemist could be advantageously utilized by the body, the intestine would absorb the waste iron already present which could not be less available than iron from the sources named.

There can be no doubt that the iron of plants is the natural and the best sources of iron for blood-making. Hence, in anemia, such vegetable foods should be selected as will supply the largest amount of iron. Fortunately, the number of such foods is ample for needed variety. More than a score of different vegetable foods supply more iron than does average beefsteak, as will be seen by reference to Table XII (Foods Rich in Iron, p. 170).

Yeast extract (Savita, Marmite), contains very many times as much iron as does average beefsteak; pure gluten 14 times as much; 40% gluten 6 times as much; egg yolk and lentils nearly 4 times, and molasses, wheat bran, yellow dock greens and

20% gluten, an average of 3 times as much. A long list of foods furnish twice as much or more iron than does moderately fat beefsteak, of which may be mentioned soy beans, peas, Protose, whole wheat, malt sugar, Malted Nuts, mustard greens, Brose and hazelnuts. The iron content of beefsteak is exceeded by that of all the whole grain cereals, dates, figs, prunes and olives, and by nearly all the nuts and nut products.

Keeping these facts in mind, it is easy to arrange a bill of fare containing an abundance of food iron in most available form. In general, the plan for the bill of fare must be as follows: For cane sugar, which contains no iron, substitute malt sugar and such sweet fruits as dates, figs, Zante currants and raisins, molasses and maple syrup. Discard white bread, polished rice, rice flakes, hominy, corn flour and all bolted cereals, and use only such whole grain products as oatmeal, cracked, shredded, or puffed wheat, wheat flakes, brown rice, graham bread, Boston brown bread, rye bread, bran and bran preparations. Make a liberal use of lentils, dried peas, navy and lima beans, and soy beans. Make greens a staple article of food, serving at least twice a day a liberal portion. Substitute nuts or nut products for meats of all sorts. Use egg yolks in moderation. Malted nuts may be in part substituted for milk because milk is deficient in iron, or altogether in cases in which the patient is sensitized to dairy products.

Fresh fruits, especially citrus fruits, and fresh vegetables. particularly tomatoes and carrots should be freely used to insure an ample supply of vitamins, a deficiency of which is known to be a cause of anemia. It is well to use tomatoes in some form every day.

Forty per cent gluten flour and biscuit contain six times as much food iron as does ordinary beefsteak. Gluten mush prepared with four times its weight of water contains half as much iron as does beefsteak, is much more easily digested, and may be eaten in much larger quantity.

Says the eminent Von Noorden respecting the feeding of children, and the same principles apply with equal force to the feeding of adults:

"The necessity of a generous supply of vegetables and fruits must be particularly emphasized. They are of the greatest importance for the normal development of the body and of all its functions. As far as children are concerned, we believe we could do better by following the dietary of the most rigid vegetarians than by feeding the children as though they were carnivora, according to the bad custom which is still quite prevalent."

Transfusion with animal blood was once much in vogue, but was soon abandoned. Such blood soon disappears when introduced into the circulation. Better results follow the transfusion of human blood of the right type. This method is now much more often used than formerly and often with results which seem little short of miraculous. Too often the effect is more or less transient, but the operation is a comparatively simple one and may be repeated many times if necessary.

DIET FOR ACIDOSIS

The blood and tissue fluids are slightly alkaline in reaction. This slight degree of alkalinity is essential to the maintenance of health. When, through disordered metabolism, the body becomes charged with an excess of acids, so that the alkalinity of the blood and tissues is diminished, the result is a condition known as acidosis. Among the symptoms due to acidosis may be mentioned nervousness, mental depression, mental confusion, drowsiness, convulsions and coma. Air hunger with shortness of breath is one of the early symptoms of acidosis. This condition is most pronounced in advanced cases of diabetes and is encouraged by a meat diet, particularly by the use of an excess of fats. Fasting persons always show a condition of acidosis after fasting for a day or two. Professor Fischer believes that this preponderance of acids, or chronic acidosis, is the exciting cause of Bright's disease. It is believed that acidosis favors the development of disease of the skin. A slight degree of acidosis is manifested in loss of endurance, physical and mental inefficiency, and slight shortness of breath.

When the increase of acids in the blood and tissue fluids is due to imperfect oxidation or disturbed metabolism, the condition is termed ketonic acidosis. When the condition is due to deficient elimination of acid wastes by the kidneys, as in uremia, it is known as renal acidosis.

A simple test for acidosis, suggested by Henderson, is holding the breath. One of the first symptoms of acidosis is shortness of breath and a sensation of air hunger. A normal person at rest after taking a full breath can hold the breath for 40 seconds or longer. When acidosis is present, the time for which the breath can be held is reduced to 20 seconds, one-half the normal or even less. When the breath cannot be held more than 20 seconds, the degree of acidosis is sufficient to render general anesthesia a highly dangerous procedure (Stange).

The opposite condition, known as alkalinosis, is believed to be associated with a condition known as tetany.

It is evidently important that attention should be given to the acid and alkaline constituents of the food. When food containing an excess of acids other than malic and citric acid is taken in considerable quantity and for some time, the result is likely to be an overaccumulation of acids. This does not occur in the case of citric and malic acids for the reason that these acids are combined with soda and potash, and in the body the acids are burned, leaving the alkalies behind, so that the effect of taking these acids in the combinations in which they are found in foodstuffs is to increase the alkalinity of the body fluids rather than to diminish it. Tartaric acid is probably burned to some extent in the body, but less readily than malic and citric acid, while acetic, butyric, oxalic and benzoic acids which are also frequently found in foods, often in considerable quantity, are not burned in the body and hence are not utilized.

When food is burned, the ashes are found to contain sulphuric acid, phosphoric acid, and hydrochloric acid in combination with lime, magnesia, soda, and potash. In some foods these acids are preponderant. This is particularly true of meats. Milk, fruits, and vegetables of all sorts contain a preponderance of the alkalies or bases. A meat diet necessarily tends to acidify the tissue fluids because of the large amount of sulphur, chlorine, and phosphorus which meats contain. A diet consisting chiefly of cereals has a tendency in the same direction, although to a much less marked degree.

Carnivorous animals appear to be equipped by Nature for dealing with these acids in a way in which non-flesh eating animals are not prepared to do. They are able to produce abundantly the alkali ammonia, from the lean meat of their diet, thus neutralizing the excess of acids derived from their diet. Human beings and other animals are not prepared to do this except to a limited extent, and hence are likely to suffer from the use of foods containing an excess of acids.

Another source of acidosis is imperfect combustion of fats.

Although sugar is the current fuel of the body, more or less fat is burned daily. The chief consumption of fat occurs some hours after a meal has been taken. More fat is consumed in the early morning hours than at any other time because at this time the starch and sugar taken in the previous day's meals have been largely consumed. Exercise before breakfast or when fasting is on this account more efficient in burning up the body fat than when taken soon after eating.

That fats are less easily utilized by the body than are starches and sugars is shown by the observation that while a person may for some days, without injury, subsist upon a diet consisting exclusively of carbohydrates, this is not true in relation to fats. On a diet consisting exclusively of fats, a state of acidosis of the tissue fluids very rapidly develops. In this condition $C\,O_2$ is accumulating in the tissues because the blood is unable to carry it off with sufficient rapidity. As a natural consequence, the amount of carbon dioxid exhaled in the expired breath will be diminished. The state of acidosis is thus most readily shown by an examination of the expired air and a determination of the so-called carbon dioxid tension. The normal tension is about 40. When the tension falls lower than 34, the condition of acidosis is present.

Hasselbalch has shown that the carbon dioxid tension of a meat-eater is only 37.8; that of a person living on a mixed diet is but little higher, 38.3; while the tension of a non-flesh eater is 43.3. These figures are highly significant. The non-flesh eater's tension is nearly ten points above the danger line, while that of the meat eater is less than four points; that is, the hearty meat eater lives continuously in a condition bordering on acidosis, and the mixed feeder is only a little better off, whereas the flesh abstainer enjoys a wide safety margin.

Here we find the explanation of the greater endurance of the flesh abstainer as compared with the meat eater. Hunters have long noted that dogs do not run well when fed meat. When riding on the top of a touring coach through the Highlands of Scotland many years ago, the writer, in chatting with the driver, learned that he was a shepherd and kept a number of dogs. When asked the question: "What do you feed your dogs?" the Scotchman replied: "The same as I eat meself, sir—brose, bannocks and potatoes."

"And why do you not give meat to your dogs?" I asked.

The instant reply was: "Because they hae nae no guid wind; they canna' rin'."

Vegetable eating animals are notable for their powers of endurance, whereas, the strict carnivora, lions, leopards and other members of the cat tribe, even though possessed of powerful muscles, become quickly exhausted when pursued.

Acidosis develops on a diet of fat because of the incomplete burning or oxidation of the fat.

Naunyn has shown that it is necessary for a person to eat daily at least two or three ounces of carbohydrates (200 to 300 calories), starch or sugar, to prevent acidosis. Carbohydrates in some mysterious way not fully understood, seem to enable the tissues to utilize fats more perfectly than is possible without them. As Naunyn remarks: "Fats burn in a fire of carbohydrates." No person can live and maintain health for an indefinite length of time on a diet which contains less than two or three hundred calories of carbohydrates. The normal diet contains 1,600 to 2,000 calories of carbohydrates or even more, while the proportion of fats is normally not more than 30 per cent of the total food intake, although in the case of diabetics, this proportion must often be considerably increased.

The amount of fat actually required by the body has been a matter of much discussion among physiologists and no definite figures have been given. Within recent years, Hindhede has shown that the absolute requirement must be very small since he was able to keep a man in perfect physical condition for nearly two years on a diet consisting exclusively of bread, potatoes and greens, without the addition of fat of any sort.

While reducing the protein to a minimum and eliminating fats from the diet, persons suffering from a chronic tendency to acidosis should also avoid meats, and should greatly reduce the use of cereals and other foods known to have a tendency to acidify the tissue fluids. In addition, they should select for their bill of fare foodstuffs which are known to be rich in base-forming, or alkaline, elements. By this means, a normal reaction balance of the tissue fluids may be maintained. (See page 183).

When the stools are foul, which is generally the case, the flora must be changed at once. Protein must be reduced to a low level, not to exceed one calory per pound of body weight, and fats must be used sparingly.

In acute acidosis, orange juice and malt sugar should be freely used. The juice of a dozen large oranges and half a pound of malt sugar may be given every twenty-four hours, even more.

The relative excess of acid or of base-forming elements found in some common foodstuffs is given in the following table:

Estimated excess acid-forming elements equivalent to one c.c. (¼ dram) normal acid per 100 *calories.*

Beef, free from visible fat	10
Eggs	9
Round steak	6.7
Oatmeal	3.2
Wheat flour	2.7
Wheat, entire grain	2.6
Rice	2.4
Corn, entire grain	0.1

Because the tissues are constantly forming acid products which must be removed by the kidneys, lungs and skin, there is always a tendency to acidosis. Vegetable foods generally tend to combat acidosis. The urine of carnivorous animals is highly acid while that of herbivorous animals is alkaline.

Infantile Acidosis.

The acidosis of infants usually results from overfeeding. The condition is indicated in young infants by convulsions and symptoms of rickets; in other children, by cyclic vomiting, headaches and "biliousness."

In the case of a young child, purées of vegetables, especially potato, tomato juice and orange juice, should be added to the diet, and the amount of food should be diminished, especially fats. Change the intestinal flora (p. 552).

In the case of older children, cane sugar should be avoided in all forms, including candy. Malt sugar may be allowed in moderate quantities. Butter and fats should be used sparingly. Meats should be avoided entirely, also animal broths. Potatoes should be largely used in place of bread. Greens should be made a part of the daily diet. A liberal serving of spinach should be eaten at least once a day. In young infants give spinach in purée. Spinach should always be parboiled.

The colon should be kept empty by the free use of bran or agar and paraffin oil. It is well to empty the colon by an enema at 80° F. at least once a day for several days.

Post-Operative Acidosis.

Acidosis always occurs in general anesthesia no matter how induced. Dangerous acidosis is most common after chloroform anesthesia, but may occur after ether or nitrous oxide. Prophylaxis is most important in these cases. Instead of being deprived of all food, as is usual, the patient should be given malt sugar freely during the twelve hours just before the operation. Eight to sixteen ounces of sugar should be taken during this time, well diluted. A little lemon or other fruit juice may be added, to suit the patient's taste. Immediately following the operation, malt sugar should be administered per rectum. Half a pint of water containing an ounce of malt sugar should be introduced into the rectum every hour. The introduction should be made slowly, if necessary employing the drip method to insure absorption. As soon as the nausea has disappeared, malt sugar may be administered by mouth, dissolved in water or diluted fruit juice. In severe cases, duodenal feeding (p. 651) with sugar water should be resorted to.

Surgical acidosis is now preventable by the intravenous injection of dextrose during the operation. This method is in regular use in the surgical department of the Battle Creek Sanitarium and has given excellent satisfaction.

SPRUE

This form of intestinal toxemia is apparently simply an advanced stage of tropical diarrhea. The disease generally originates in tropical countries, but after it has once become well developed, may continue in spite of removal to a different climate.

The first dietetic indication is to secure a change of the intestinal flora. In addition, it is highly important to include in the dietary an abundant supply of vitamins and iron and lime with the other organic salts associated with them. These indications are best met by a diet consisting of milk and fruit.

At the beginning, milk should be given warm and in small quantities, not more than half a pint, at intervals of two hours. The first day the quantity should be not more than two or three pints. The amount should be gradually increased to seven or eight pints, when the patient will usually begin to show a gain in weight.

Strawberries have been the most highly recommended of any fruit, but in cases under the writer's observation other fruits have appeared to be quite satisfactory. One or two pints of strawberries should be eaten daily, or three to six bananas, or bananas and strawberries may be used together. The fruit should be thoroughly ripe.

When fit for use, the skin of the banana is brown. Bananas should be eaten only in the form of purée, produced by removing the coarse fiber and mashing or putting through a colander. It is a good plan to mix the banana with a portion of milk or cream and beat with an egg beater.

According to Thim, sprue is due to a poison which develops in certain media, particularly in such a medium as is supplied by flesh foods, but appears to be unable to develop in milk or the juices of fruits. He explains in this way the great benefit derived from a diet of milk and strawberries or other fruit.

Yogurt buttermilk, and particularly milk soured with *B. acidophilus,* greatly facilitates the process of changing the intestinal flora. Purées of spinach and other greens to the extent of six to eight ounces daily may be used with advantage for the purpose of furnishing iron, which is deficient in milk and is found in only comparative small proportions in most fruits. The superior value of the strawberry in these cases may be in part due to the fact that it is richer than other fruits in iron.

Hot cornstarch enemas should be used twice daily to thoroughly cleanse the colon and hasten the change of flora. An ounce or two of milk sugar may be added to the enema with advantage to still further encourage the development of *B. acidophilus* in the colon. Enemas of whey cultures of *B. acidophilus* are also highly useful.

Brown (*Am. Jour. Med. Sci.*) reports a number of cases of sprue treated successfully with five to ten grains of pancreatic extract three times a day. The extract is given two hours after meals in connection with 20 grains of bicarbonate of soda. This method of treatment was adopted because of the finding of the complete absence of pancreatic ferments in the duodenal contents. Patients remained well so long as they continued the use of the pancreatic extract. The diet consisted of buttermilk, bread and milk, fruit purées and fruit juices, an excellent antitoxic diet.

HODGKIN'S DISEASE

The patient is subjected to the influence of toxins continually absorbed from the seat of the disease, and hence the greatest care should be taken to reduce the alimentary toxins to a minimum. This may be accomplished by first changing the intestinal flora, by methods elsewhere described (p. 552), and then adhering closely to the antitoxic and laxative diet.

Anemia and demineralization should be combated by the free use of greens and other foodstuffs rich in iron. (See Table XII, p. 170).

HEMOPHILIA

The diet should aim to enrich the blood in lime. A milk regimen is especially indicated. Three or four quarts of milk a day, half a pound of spinach, and an ounce and a half of bran may with benefit constitute the regimen for one to three weeks. The most efficient remedy is a transfusion of blood, the effect of which is immediate but, unfortunately, not permanent.

DIET IN GOUT AND OTHER SO-CALLED URIC ACID DISORDERS

The modern refined methods of chemical examination of the blood has led to the discovery of the fact that uric acid is not infrequently present in the blood in excessive amount. It has also been established that this excess is one of the earliest indications of renal failure. This fact is now recognized as of great diagnostic value. It is equally important as a dietetic indication. When the kidneys are no longer able to keep the blood normally free of uric acid, the fact shows that the process of renal degeneracy has reached a pretty advanced stage. The margin of safety which Nature provides for emergencies and to draw upon in advancing age, has been used up. The kidneys are old, in other words, and Father Time is preparing to execute judgment.

While it is more than probable that many disorders for which uric acid is not responsible have been erroneously charged to its account, it nevertheless cannot be denied that uric acid is a highly toxic excretory product and that the tissues should be kept as free as possible from it. Since it is now known that the human liver is not able to convert uric acid into urea or some allied non-toxic substance, it is clearly evident that one who wishes to live long and preserve his liver and kidneys intact to a good old age must eliminate uric acid from his dietary as fully as possible. There is no doubt of the truth of the statement by Tibbles that "The persistent consumption of foods containing a large percentage of purin bodies is apt to lead to their accumulation in the organism. So long as the liver can transform and the kidneys excrete puric bodies, no harm, it may be thought, will follow. But a constant irritation of the kidneys by an excess of purins, especially uric acid, may result in chronic nephritis of the gouty variety, with other evidences of chronic gout. The retention of purins (uric acid) in the system is amongst the recognized causes of gout, rheumatic gout, uric acid gravel, uric acidaemia, migraine, neuralgia, sciatica, epilepsy, vascular diseases, and many other conditions of ill-health."

To avoid uric acid, it is practically necessary to do nothing more than to exclude meats from the dietary, for the amount of uric acid found in beans and other vegetable foods is too small to be of any significance. For example, beans contain 4 grains of uric acid to the pound. A pound of baked beans containing one grain of uric acid is practically equivalent in food value to a full pound of meat containing 14 grains of uric acid in the case of beefsteak, or 70 grains in the case of sweetbreads.

Meat extracts, bouillon and animal broths of all sorts must be rigorously excluded from the dietary.

It is equally necessary in cases in which uric acid elimination is deficient to combat intestinal toxemia by a laxative and antitoxic diet and by changing the intestinal flora (p. 552). The ability of the kidneys to eliminate other poisons as well as uric acid is lowered. These essential organs are seriously crippled, and their task must be made as easy as possible. (See Bright's Disease, (pp. 446, 756).

DIET IN SCURVY

Scurvy has been long recognized, and an efficient mode of treatment has been known, but only recently has the disease come to be well understood. It is now known that natural foods contain a subtle element, the antiscorbutic vitamin (p. 186), the absence of which leads to the terrible consequences sometimes seen in persons deprived of foods containing this vitamin in sufficient amount. This vitamin is, of all the vitamins, the most easily destroyed. Ordinary cooking destroys it, as does also drying and other means of preservation. It has recently been shown that quick drying and drying in the absence of air, prevents the destruction of the anti-scorbutic vitamin by preventing oxidation.

Observations by Plimmer have recently shown (*Biochemical Journal*), that pigs are much subject to scurvy, which is shown by stoppage of growth, lack of appetite, swollen joints and other symptoms observed in scorbutic animals. This disease is the result of using cooked food, which in the winter time is the common food of pigs. Cooking destroys the antiscorbutic vitamin. This disease is sometimes called "pigs gout, rickets, or rheumatism."

Thousands of human beings are unwittingly suffering to a greater or less extent in a similar way as the result of the too exclusive use of cooked foods.

Preserved foods cannot be made an exclusive diet without the development of scurvy. The body stores up vitamins in the liver and other tissues, sometimes more and sometimes less. The length of time one can live on a diet lacking the scurvy-preventing vitamins without contracting the disease will depend upon how much of this particular vitamin he happens to have in store. A few weeks, at the most, will exhaust the reserve, and then the disease makes its appearance and nothing but a new supply will cause the distressing symptoms to disappear.

Fresh foods are the only remedy for scurvy. The fresh juices of oranges and lemons is particularly rich in the antiscorbutic vitamin. The lime has little value, as has been shown by the failure of lime juice to prevent the disease. The juice of tomatoes, even of canned tomatoes, is perhaps as good as orange juice. Several ounces a day of these juices or their equivalent are required to prevent or cure scurvy.

Turnip juice, cabbage, lettuce, all green and uncooked vegetables, are of proven value. The potato is strongly antiscorbutic, even when cooked, as well as the tomato.

Skimmed milk (unboiled), whey, cottage cheese, and buttermilk, are good antiscorbutics. Pasteurized milk is better than boiled milk but is inferior to fresh, raw milk. Almost any sort of green stuff will serve in emergency, as alfalfa or clover leaves or even grass. The fact that gardens were little cultivated in the Middle Ages and green vegetables on this account little used. doubtless explains in large part at least the great prevalence of scurvy during that period.

The idea that meat is essential as a preventive of scurvy is an error. In the famous siege of Kut-el-amara in Mesopotamia, during the World War, scurvy was very prevalent among the British soldiers, whose rations consisted of white bread or biscuit and tinned meats, but long unknown among the Indian soldiers, who ate no meat but added to their wheat bread a legume known as dhal. The East Indians finally succumbed to scurvy through starvation, but were cured by three ounces daily, per man, of green herbs collected from the plains. The use of yeast extract was found of great value in preventing and curing beri beri (*Brit. Med. Jour.*).

Recent studies of the antiscorbutic properties of various foodstuffs have shown that cows' milk, even when fresh and neither pasteurized nor sterilized, possesses rather feeble antiscorbutic properties, notably less than mothers' milk. This is probably due to the fact that the calf, being born with teeth, when a few days old begins nibbling at tender green shoots of grass and herbs, and thus begins to supply itself with the important antiscorbutic vitamin which is found in all green leaves as well as in the juices of most acid fruits and fresh vegetables.

Another fact of recent discovery is that the antiscorbutic properties of cows' milk vary greatly with the food of the cow. In winter when the cows are fed chiefly upon hay, oil cake and other dry foodstuffs, the antiscorbutic properties of the milk are very greatly diminished, and bottle-fed infants using the milk of such cows are likely to develop scurvy even though perfectly fresh, certified milk may be used. Orange juice or tomato juice is just as necessary in such cases as when sterilized milk is employed. When cows are fed on swede turnips, the milk is richer in the antiscorbutic vitamin, which is found in abundance in swede turnips although not in the rutabaga. Silage is lacking in the antiscorbutic vitamin, which is destroyed by fermentation. As a means of safety, all infants fed on cow's milk should be given an ounce or two of orange or tomato juice, daily, so long as cow's milk or milk and "infant foods" or cereals remain their chief or exclusive diet.

Scurvy in partially developed forms generally known as malnutrition is one of the most common of diseases. Thousands of puny, weazened and short-lived infants and perhaps millions of ailing and inefficient adults are victims of this nutritional disorder, to correct which is one of the great and worth-while tasks set before the rising generations of dietitians.

Greens and salads are of great use in the prevention of scurvy as well as other deficiency diseases. The following cultivated plants make good greens: "Radish tops, turnip tops, beet tops, Swiss chard, kale, Chinese cabbage leaves, upland cress, French endive, cabbage sprouts, asparagus, New Zealand spinach, dandelion, native mustard and horse radish leaves, Russian mustard, collards, rape, tender tips of alfalfa, lettuce." In addition to the above cultivated greens the following uncultivated ones are good to eat and some of them are superior to most of the cultivated varieties of greens. "Wild dandelion, wild lettuce, sour dock, lamb's quarter or pig weed, wild mustard, pepper cress, smartweed sprouts, purslane, marsh marigold, tender sprouts and young leaves of milkweed, young thistles."

It was shown by Fürst that the antiscorbutic, or scurvy-preventing vitamin, is produced in the germination of plants Fortunately, this vitamin is not destroyed by heating to a temperature of 158° F., which is necessary to gelatinize starch. For this reason non-alcoholic malt extracts are useful in the scurvy of infants. Sprouted grain or soy beans may be used as salads.

PURPURA

The diet should be the same as in pernicious anemia, with special attention to antiscorbutic foods.

A pint to a pint and a half of orange juice daily, one or two pounds of fresh tomatoes, the juice of half a dozen turnips, potato soup, sprouted barley or sprouted soy beans with lettuce and other salads are especially helpful food remedies.

SEPTICEMIA

The patient should take an abundant supply of water, at least three to four quarts daily. Malt sugar or raisin water should be freely used. A good plan is to add to each pint of water administered two ounces of malt sugar or the juice of four ounces of raisins. A glassful of water should be given at intervals of every half hour during the day. If the patient cannot take the full amount of water by the stomach, it should be given per rectum in such a manner as to secure absorption.

Purées of greens should be used liberally to maintain the blood in a condition to combat the invading germs. Meats of all sorts should be discarded. The fever diet should be carefully followed until convalescence, after which the antitoxic and laxative diet will be indicated.

OSTEOMALACIA

This disease requires a reconstructive regimen. Milk, whey, buttermilk, greens of all sorts and other foodstuffs rich in lime are especially indicated.

ANOREXIA

The absence of appetite is one of the most constant effects of profound toxemia. When the intestine is loaded with putrefying material, the products of putrefaction are absorbed into the blood in great quantities and produce profound disturbance of all the nutritive functions. The thirst center as well as the hunger center is often depressed to such an extent by the bacterial toxins circulating in the blood that the appetite for water as well as for solid food is almost wholly lacking. The tongue is coated, there is a bad taste in the mouth, and the very thought of food is often nauseating. There is complete perversion of the gustatory sense in certain cases, and lack of appetite even when the tongue is clean; but in these cases, also, stasis in either the large or small intestine is rarely absent.

In the majority of cases, the X-ray will show incompetency of the ileocecal valve, as the result of which there is a reflux of putrid material into the small intestine and absorption of toxins into the general circulation.

The first thing to be done, of course, is to remove the cause by changing the intestinal flora. In the meantime, even though the patient may be weak and emaciated and greatly in need of food, it would be useless and even highly detrimental to urge upon the patient the taking of rich or hearty foodstuffs. Even milk often aggravates the situation rather than relieving it. The best thing to be done is to put the patient at once upon a fruit fast or the fruit regimen (p. 532).

In the majority of cases, the patient will by the second or third day, under this dietetic regimen, acquire a natural appetite. Not infrequently, the appetite becomes so keen that the simplest food is taken with zest. If the patient is much emaciated, it is well to administer in the intervals between meals eight to ten ounces of milk sugar daily. The sugar should be taken dissolved in water or fruit juice. Three ounces of milk sugar three times a day with the fruit regimen, is the most effective means of changing the intestinal flora.

When the tongue clears off readily after two to four days of the fruit regimen, the patient, if very thin in flesh, should be put upon the milk regimen for two to four weeks (See p. 539).

In the application of the milk regimen and the fruit regimen, the greatest care must be exercised to observe every detail indicated elsewhere (pages 539, 532).

In cases in which the appetite still remains deficient and fickle after the application of the above measures, the patient must be encouraged to eat liberal quantities of food, even though appetite is lacking. This may best be accomplished by administering the food in very simple, rather concentrated form, in small quantities at frequent intervals. Fats and proteins should be eaten sparingly, the diet consisting chiefly of carbohydrates.

Carbohydrates, especially in the form of fruit juices, with or without the addition of malt sugar, are readily taken when foods rich in fats and proteins are not relished. It is highly necessary that the protein constituent of the food should be reduced to a minimum. By so doing, the production of toxins in the intestine is lessened, and the liver and other excretory organs are relieved of the task of eliminating unnecessary and unusable protein.

Fats should be taken in the form of emulsion as cream or butter or cream mixed with an equal or greater amount of Malt Honey. This combination is very readily accepted by stomachs unable to take fat in any other form, and is highly palatable.

By reference to the table of food values, it will be noticed that many fruits have a caloric value considerable in amount, and by the addition of malt sugar, with or without cream, the caloric value can be greatly increased, more than doubled in most cases.

The application of an ice bag over the stomach for half an hour before eating will often induce an appetite. Continuous living out-of-doors day and night, a cold bath morning and night, and a moist abdominal bandage, are other measures which greatly encourage appetite. Care must be taken to keep the colon empty by employing the enema twice a day if necessary, and by the free use of laxative foods and other laxative means (page 580).

DIET IN JOINT DISEASES

CHRONIC RHEUMATISM

Within the last few years, since it has become known that infections of the teeth and tonsils are often associated with chronic inflammation of the joints, so-called chronic rheumatism, it has become a fashion to attribute all cases of this disease to mouth infections. This is an error. There are many rheumatics who still suffer from painful joints after having not only their tonsils but all their teeth removed. It is becoming more and more evident that in a considerable proportion of cases the real seat of the disease is in the colon. Infections of the colon such as are always present in colitis, at least in incipient form, whenever the stools are putrid or foul-smelling, may be found to be the chief source of chronic rheumatic affections of various forms.

In the treatment of this disease, the colon should always receive attention, even when the teeth and tonsils are found diseased. The diet should be so regulated that the stools lose their foul odor and the bowels move three or four times daily. It is generally necessary to empty the colon by means of the enema at least once a day, even when using agar or bran, paraffin oil, fresh fruits and vegetables and various other dietetic means by which peristalsis may be encouraged.

It is clear that the indications in rheumatism are for a strictly antitoxic diet and the free use of laxative foods after the flora has been changed (p. 552).

The popular notion that acid fruits should be avoided in rheumatism is wholly an error, for the reason that fruit acids are oxidizable in the body like sugar and behave like carbohydrates, not as mineral acids. In all foods in which they occur they are found in combination with the organic bases, soda and potash. When eaten, the acids are burned or oxidized setting free the bases, so while the acid has a sour flavor and produces acid effects in the mouth and stomach, when absorbed into the blood the acid disappears, leaving behind the soda and potash which serve a useful purpose in rheumatism by neutralizing the acid products of tissue wastes which have a tendency to accumulate in this disease. Melons, and especially the musk-melon, are especially valuable in rheumatism because they tend strongly to alkalinize the blood and tissue fluids. The cantaloupe is in this respect more efficient than any other fruit. Potato soup or purée should appear often on the bill of fare of the rheumatic patient on account of its rich store of bases which alkalinize the tissue fluids, and potatoes and root vegetables should largely take the place of bread and cereals.

Pemberton has shown that a temporary reduction in the food intake produces brilliant results in the treatment of this disease. The food should be reduced to the base ration, or about two-thirds the usual amount of food eaten. In some cases a still further reduction is necessary. Pemberton has also shown that in this disease there is a marked increase of creatinin which is a clear indication for the elimination of meats of all sorts. It is, of course, to be understood that these dietary restrictions are not to be relied upon as the only therapeutic measure but are to be used in connection with hydrotherapy, especially local applications and sweating baths, sun baths, the arc light, hot applications to the affected joints and other rational measures.

OSTEOARTHRITIS—RHEUMATOID ARTHRITIS

Dr. Helen Baldwin, who made in Herter's laboratory in 1904 a study of 21 cases of rheumatoid arthritis, found excessive intestinal putrefaction constantly present in cases in which the disease was active. There were also found in the urine abnormal organic acids which had evidently escaped oxidation in the body.

This disease is without doubt, in many cases, the result of intestinal toxemia and other forms of autointoxication. On this account, the diet should be strictly antitoxic. The bowels should be made to move very freely and in bad cases should be completely emptied by enema once a day. Changing the intestinal flora by means of the fruit regimen and by the introduction of the *B. acidophilus* into the colon, as well as taking the culture by mouth (p. 552), are measures which have shown themselves to be of value in dealing with many cases of this disease.

ACUTE POLYARTHRITIS

This disease is now generally thought to be due to focal infection. The source of infection may be diseased tonsils, the teeth, an infected appendix or gall-bladder, a chronic infection of the cervix uteri, gonorrheal infection, or an infection of the colon (colitis). The last named is probably the most common source of infections of this sort.

The modern treatment of this condition consists of rest in bed, the application of plaster casts to secure complete rest of the joints, fomentations and heating compresses to the joints. After the most acute stage has passed, the application of the arc light, the hot and cold pour to the joints, and the general electric light bath are highly useful.

Most important of all is regulation of the diet which in general should be like that of other febrile conditions (pp. 575, 769). The flora should be changed by the fruit regimen combined with lactose or dextrin feeding, three ounces three times a day for a week or two, until the stools show *B. acidophilus* dominant. Greens, fresh fruit, and fresh vegetables should be freely used to supply lime, iron and vitamins. Cereals should be used sparingly. Potatoes should largely replace bread. The bowels should be emptied at night by enema, even though there may be one or two natural movements.

GOUT

Much less importance is in recent years attached to uric acid as a cause of specific disease than in former times. However, it is perfectly well known that the output of uric acid in the urine is diminished in gout, while uric acid is found in the blood in increased amount. The association of uric with gout is unquestionable; hence it is clear that foods rich in uric acid should be avoided in this disease. This requires exclusion of meats of all kinds and animal extracts and broths of every description. Foods rich in oxalates or oxalate of lime should likewise be forbidden. Cereals should also be restricted because they leave behind in the tissues a preponderance of acids which lessen the alkalinity of the blood and tissue fluids and so diminishes the solubility of uric acid and encourage its accumulation in the tissues. The free use of potatoes and other root vegetables is indicated because of the fact demonstrated by Hindhede, that the rich store of sodium and potash salts found in these vegetables increases the solubility of uric acid and helps to remove it from the body. With an ordinary mixed diet including meat, the urine was found to be completely saturated with uric acid and would not take up even a small additional quantity, whereas when potatoes were freely used, the urine was able to dissolve considerable additional quantities of uric acid.

It is generally recognized that gout is little known among people who live chiefly on vegetable foodstuffs. It is essentially a meat eater's disease. For this reason gout, while common among city dwellers in England, is little known among the Scotch and is also uncommon among the people of Southern Europe. Gout is unquestionably one of the consequences of chronic intestinal toxemia. The kidneys become worn out by the demand made upon them for the elimination of toxins, and the result is accumulation of uric acid in the blood and tissues. The toxins produced by the putrefaction of meat residues in the colon excite cell activity, especially in the endocrine glands and so increase the production of uric acid. The suppression of colonic putrefaction is one of the first things to be done in this disease by the exclusion of meats (fish, flesh, fowl) and change of the intestinal flora (p. 552). It is the writer's belief that the putrefaction of meat residues is a much larger factor in the production of gout than the uric acid found in meats.

All foods which lessen the alkalinity of the fluids will certainly increase the prediposition to gout. Hence, besides eliminating meats and to a large extent eggs from the diet, care must be taken to give special prominence in the bill of fare to such foods as potatoes, turnips, beets, cabbage, cauliflower, spinach, greens of all kinds, Brussels sprouts and other fresh vegetables.

The influence of diet upon the nervous system must also be considered in this disease, as illustrated by the case of the famous surgeon, John Hunter, of whom it is related that "when not yet fifty years of age he suffered an attack of gout, accompanied with cardiac symptoms. At fifty-five he had an attack of angina and was never quite well afterward. . . The attacks were easily induced by anger, and he used to say that his life was at the mercy of any knave who should chance to worry him." He died soon after in a paroxym of anger. The irritating effects of a flesh diet are well known, as shown in the effect of meat feeding upon dogs and other animals.

A fruit diet aids in the elimination of uric acid by increasing the alkalinity of the blood and thus its solubility. This statement does not rest on purely theoretical grounds but may be demonstrated by anyone who will take the trouble to make the simple experiment of placing himself for a few days upon a fruit diet and making careful comparative examinations of the urine.

Some years ago the writer made a study of the effects of fruit upon the elimination of uric acid in a number of medical students who were placed upon a diet consisting almost exclusively of fruit, the only addition being a small amount of dry toast. The urea was, of course, diminished as the nitrogen intake was greatly reduced, but the output of uric acid was very considerably increased, on the average doubled, and in some cases more than doubled. A variety of fruits was given, chiefly grapes, bananas, apples, oranges and peaches. The source of the increased output of uric acid was doubtless the quantity of this waste element which had been stored up in the tissues. By the increased alkalinity of the blood, its ability to dissolve the uric acid from the tissues and transport it to the kidneys was increased and thus the output was increased. In a later experiment in which the fruit diet was continued for more than a week, it was observed that the increased output of uric acid continued only for a few days. After the first three or four days, the acidity of the urine decreased rapidly, and at the end of the week the urine was nearly neutral.

DIET IN DISEASES OF THE HEART AND BLOODVESSELS

In this disorder, degenerative changes take place in the heart and bloodvessels in all parts of the body. In some cases there is a progressive rise in the blood pressure as the disease advances. In many, perhaps the majority of cases, the blood pressure is only slightly or not at all raised.

As regards the cause of the disease, Huchard says, arteriosclerosis "begins by intoxication, continues by intoxication and ends by intoxication." This intoxication may have various sources, but in the opinion of Huchard and other equally eminent authorities, the most common origin is the intestine through the putrefaction of undigested remnants of food proteins, especially flesh meats, and the absorption of the putrefaction products in quantities greater than the liver is able to destroy or the kidneys to eliminate.

Another remark by Huchard is well worth quoting: "The origin of the disease is alimentary, the lesion vascular, but the danger is renal. As the disease advances, the kidneys become less and less efficient and the final catastrophe is in a large percentage of cases due to renal failure."

Professor Huchard also held that the great frequency with which arteriosclerosis is encountered in modern times is the result of the increase in flesh eating which in recent years has been very marked in all civilized countries.

Boix of Paris produced arteriosclerosis by feeding rabbits extracts of feces and cultures of colon bacteria.

Dr. Herbert Fox, Director Laboratory of Comparative Pathology, Philadelphia Zoological Garden, has shown that arteriosclerosis occurs in certain wild animals when subjected to the conditions of captivity.

Among the interesting observations made by Dr. Fox is the fact that the glands of internal secretion, the pituitary, adrenal and thyroid glands, are larger in cats, dogs and eagles—flesh-eating animals—than in lemurs, rodents and rabbits, animals which live on fruits, nuts and tender shoots.

Dr. Fox also observed that arteriosclerosis is found most definitely developed in animals living upon a meat diet and hence subject to autointoxication.

On the whole, arteriosclerosis is found much less frequently in lower animals than in human beings, doubtless for the reason that, in general, animals live more physiologically than do human beings.

An interesting contrast was found between horses and dogs in the fact that it is doubtful whether arteriosclerosis ever occurs in horses, although they often attain very great age. On the other hand, in the case of dogs, arteriosclerosis is comparatively frequent. A sufficient cause for this difference is found in the difference in diet. Horses are herbivorous, while dogs are carnivorous. Meat-eating man, exposes himself to the same causes of arteriosclerosis as those to which the meat-eating dog is subjected. This fact is so well known, it has become the universal custom among practical physicians to exclude meats, meat extracts and broths of all sorts from the diet of patients suffering from arteriosclerosis, as the most efficient means of checking the degeneration of the arteries to which the disease of the blood-vessels is due. It is evident that the same dietetic restrictions which will arrest degeneration of the blood vessels when this process has begun, must be an effective means of preventing this destructive change, or at least of delaying its appearance. Dr. Harvey, who examined the body of Old Parr who was much more than a centenariain (reputed age at death 152 years), found no evidence of arteriosclerosis in his body. Parr's diet consisted of potatoes, greens, coarse bread, and buttermilk. He rarely ate meat.

The first thing to be done in arranging the regimen of a person suffering from arteriosclerosis is to change the intestinal flora (p. 552). The flora of this class of patients always needs changing. In a very large proportion of cases, Barger and Walpole demonstrated the production of pressure-raising poisons by putrefaction. According to Dixon of King's College, London, pressure-raising poisons are produced in the intestine, and Bain demonstrated the presence of these poisons in the blood and urine of persons having high blood pressure. Experiments have shown that a non-flesh diet reduces the amount of these poisons found in the urine. A biologic diet must be closely adhered to, not merely for a few weeks or months, but so long as the individual lives.

The diet to be followed in arteriosclerosis is a strictly antitoxic and laxative dietary. All foods containing uric acid in appreciable amount must be discarded. This naturally excludes meats of all sorts, fish, flesh, fowl, and shellfish, together with meat extracts, broths, bouillons. Reference to the table showing the uric acid content of foodstuffs will show at once the necessity for the elimination of the articles named.

Tea and coffee must be discarded for the same reason. A cup of coffee contains more than double the amount of purin (uric acid) found in normal urine. Uric acid is chemically a xanthin compound. Caffein is also a xanthin compound, tri-methylxanthin. Mendel and Wardell have shown that an intake of caffein is followed by an increase of uric acid in the urine.

Foods rich in oxalic acid, such as sorrel and rhubarb, must be discarded.

Eggs must be used sparingly. The yolks are preferable to the whites. Raw eggs should not be eaten.

Potatoes and other farinaceous roots should be largely used in place of cereals, breads and breakfast foods, because of the rich supply of organic bases which they afford and which neutralize the acids arising from tissue wastes always present in excessive quantity in persons subject to arteriosclerosis or high blood pressure. Fruits should be freely used and greens in sufficient amount to furnish an adequate supply of lime and iron.

Bran, agar, and paraffin oil should be used freely enough to secure three bowel movements daily and the enema should be used at night, in addition, two or three times a week, when a considerable amount of residue is found to be still present after the last bowel movement, as ascertained by administering an enema.

In every case of arteriosclerosis the carmine test (p. 518), should be applied to determine how long the food residues remain in the colon. If more than 24 hours elapse before the red color disappears from the stools, further stimulation of intestinal activity is necessary and the amount of bran and paraffin oil should be increased. The daily use of the enema of moderate size (2 to 4 pints), is in no way harmful, while drug laxatives of any sort are highly injurious when frequently resorted to.

HIGH BLOOD PRESSURE

The diet in high blood pressure should be the same as that suggested for arteriosclerosis (see above). Tea, coffee, tobacco, condiments, and flesh foods of all kinds must be discarded. The bowels must be made to move freely (three times a day), by the use of laxative foods, bran, agar, and paraffin oil. Vigorous measures for changing the intestinal flora should be adopted and continued or repeated until the stools cease to be putrid. In many cases the colon is so crippled that the fruit regimen for changing the flora (p. 552), must be repeated every few weeks in order to maintain a normal flora; that is, to prevent the recurrence of putrid stools. The adoption of an antitoxic and laxative regimen after changing of the flora in these cases generally results in a pronounced lowering of the blood pressure within a few days, at most within a month. In the case of young persons, or when the high pressure has existed only for a short time in older persons, the pressure can often be brought back nearly to normal. It is not an uncommon experience to see the pressure drop from 200 to 150 or even lower within a few weeks, and by a careful regimen it may be kept down for years and useful life and activity may thus be prolonged. Dr. M. A. Mortensen, of the Battle Creek Sanitarium medical staff, recently reported the case of a patient, a man past middle age, whose blood pressure was reduced from 260 to 160 and still remained at this point after seven years, with the disappearance of other symptoms of ill health. Similar results have been obtained in thousands of like cases.

It is more than probable that colon poisons resulting from the putrefaction of meat residues in the colon are the most active of all causes of arteriosclerosis which are ordinarily encountered. Dale showed that para-hydroxylphenyl-ethylamine, a poison found in decaying meat, acts like supra-renal extract, and raises the blood pressure at once from 110 to 260. Hence, the great importance of a low protein and fleshless diet in these cases.

APOPLEXY

The diet in apoplexy should be the same as that for arteriosclerosis. Special care must be given to the regulation of the bowels, on which account a large amount of roughage, together with paraffin oil in liberal doses, may be needed because of the patient's inactivity. For the same reason, the intake of food should be considerably diminished. If the patient is obese, the diet may be reduced to two-thirds of the standard dietary for the individual until there is an appreciable diminution in weight. The flora must be changed and the antitoxic and laxative diets must be closely adhered to. The stool should never be allowed to become hard or putrid. The bowels must be moved thoroughly three times daily. The enema should be used at night once or twice a week or more often, to insure complete emptying of the colon. It is well to resort for a few days to the fruit regimen (p. 532), once a month, to keep the flora in good condition.

ANEURISM

The diet to be followed in aneurism is the same as that in arteriosclerosis and high blood pressure. Care should be taken to avoid overeating and drinking too freely, also to avoid constipation. The bowels must be kept very free, and the stools as nearly odorless as possible. The colon should be fully evacuated three times a day. An enema (2 or 3 pints, at 90 degrees F.), should be used at night to insure complete emptying of the colon when the bowels do not move freely. The flora must be changed (p. 552), and kept changed by applications of the fruit regimen as often as may be necessary for the purpose.

ANGINA PECTORIS

The proper dietary is the same as that for arteriosclerosis and high blood pressure. Great care should be taken to avoid overdistention of the stomach and foods which are known to "disagree." Hot drinks, ices, pickles, and indigestibles of all sorts must be carefully avoided. Flesh meats should be discarded wholly and eggs should be eaten sparingly. The diet indicated for arteriosclerosis (p.739) should be carefully followed.

DIET IN MYOCARDITIS

In ordinary mild cases of cardiac disease, an antitoxic and laxative dietary is indicated. If the patient is anemic or emaciated, the usual reconstructive diet is indicated (page 000). In cases of obesity with myocarditis, or other grave heart lesion, very careful dieting is of greatest importance. Active exercise must be avoided in these cases because of the cardiac weakness; hence, the reduction of weight must be accomplished by restriction of the diet. A low protein regimen, such as is afforded by the antitoxic diet (p. 568), with a proper diminution of the amount of food eaten, is usually sufficient. Meats are, of course, contraindicated for the reason that they encourage the degenerative process, which is the essential factor in the case. Fats must also be restricted and need not constitute more than 10 per cent (calories) of the dietary. The protein should not exceed one calory per pound of body weight. The total ration may be reduced from one-third to two-fifths the normal amount for an individual of a given height. The Karell method of milk feeding has been highly recommended in cases of this sort and has often been used with success. It is doubtful, however, if it has any specific virtue other than the reduction of the amount of food ingested and the elimination of meats of all sorts.

In cases of marked heart weakness coupled with dropsy and inability of the kidneys to eliminate the normal amount of water, a saltless diet is essential with great restriction of the fluid intake. The amount of fluids taken should, for a few days, not exceed two or three pints. In some cases the amount may be still further reduced for one or two days (salt-free diet and dry diet, pages 447, 608). But the low fluid intake must not be continued too long. The fluid food should consist of malt sugar in water or fruit juices. A moderate intake of food secures better results than complete fasting for the reason that it promotes the elimination of the sodium chloride, which is responsible for the accumulation of water in the tissues. Care must be taken to keep the bowels open by means of the enema and the free use of bran or agar and paraffin oil.

DIET IN NERVOUS DISORDERS

HEADACHE

Most headaches are toxic. The most usual source of the poisons is the colon, which is a veritable Pandora's Box of poison-producing germs and their noxious products, some of which equal the venoms of snakes in virulence.

Many headaches are no doubt the result of the breakdown of the liver defense. As the late Professor Lauder Brunton wisely remarked, "The liver is the porter which stands at the gate of the organism to prevent all deleterious substances which enter the blood vessels from the intestine from reaching the general circulation. These substances are caught up by the liver and destroyed, or excreted unchanged into the intestine, where they may pass away with other feces. But many of these substances may be re-absorbed, and so they form a constant round from bowel to liver and liver to bowel, until at last they amount to so much that the liver cannot deal with them, and they pass into the general circulation. A period of time is required for this accumulation, which varies even in the same person, and occurs in less time with a highly nitrogenous diet. Absorption from the liver is influenced by the emotions, so that after emotion a person may become jaundiced; therefore we may expect anything which is circulating with the bile would be rapidly absorbed. Anxiety, grief or sorrow, is apt to bring on a headache, and there are good reasons for attributing the headache to the presence of abnormal constituents circulating in the blood. Why do the toxins fasten on the head and cause a headache instead of causing a pain in the intestines or big toe? It is because there is some factor, perhaps a local lesion, which determines the pain to the head. The most common determining causes are decayed teeth, astigmatism, myopia, hypermetropia, presbyopia, nasal or pharyngeal trouble, disease of the antrum of Highmore, or of the frontal or ethmoidal sinuses, glaucoma, periostitis, or neuritis."

There are now few authorities who question the toxic origin of migrain. Starr, one of the leading neurologists of this country, holds that migrain is due to an unidentified toxin and that hemicrania, a somewhat similar disorder, is due to the same cause. Other investigators attribute the disorder to uric acid and other toxic bodies derived from protein.

Dr. F. Hare some years ago, and more recently, Mercier, have called attention to the fact that an excess of fat in the diet is often the cause of headache. Headaches due to this cause are usually worse in the morning. Fats may easily become a cause of headache. When present in excess they increase intestinal putrefaction and autointoxication.

With this explanation of the cause of headache, it is evident that the most promising outlook for relief is in the direction of dietetic control.

Most persons subject to headache are found to present coated tongues and foul breath, an indication of saturation of the tissues with putrefaction products derived from the colon.

The first step is to change the flora of the colon (p. 552). This must be done thoroughly. Often two or three attempts will be needed for complete success. After four to six days on the fruit regimen a more liberal diet may be allowed for three or four days, and then the fruit regimen should be resumed for another period of four to six days. As the tongue clears and the colon becomes more active, the headaches will grow less frequent and finally disappear. The writer has seen this occur in many hundreds of cases.

In occasional cases, a crippled state of the colon will complicate the situation and delay success. The incompetent ileocecal valve, adherent pelvic colon, adherent appendix or cecum and spastic colon, are serious hindrances which must be reckoned with. A diseased gall-bladder is another troublesome complication. Sometimes surgery is necessary.

Removal of a few ounces of bile by means of the duodenal feeding tube two or three times a week is a measure which may be worth trying. Four to six ounces may be removed at each passage of the tube until a total of a pint and a half or two pints have been removed. Lemon juice (one to three of water) or a solution of citric acid (two per cent.) may be used to excite contraction of the gall-bladder instead of magnesia sulphate. Still better is the use of hydrochloric acid, the normal stimulant of the gallbladder and disinfectant of the stomach and the duodenum.

Many persons subject to headaches notice the beneficial effects of acid fruits for which they often have a craving, which is perhaps due to the fact that the gall-bladder and liver are made to discharge more freely while peristalsis is hastened, so that less is absorbed, and thus some of the stock of stale bile is gotten rid of.

Many persons have experienced relief from headache after vomiting a quantity of very bitter, evidently highly concentrated bile. The relief experienced from purgation by "salts" or calomel is doubtless due to the same cause,—the getting rid of a quantity of concentrated and highly poisonous bile. Bouchard showed that bile is six times as toxic as urine.

After the flora is changed, the laxative (p. 580) and antitoxic (p. 568) diets must be consistently followed.

Tea and coffee must be avoided. This is imperative. While a cup of tea or coffee is often resorted to as a means of relief from headache, the benefit is only apparent and is delusive. The cause is not removed, and the disorder is definitely aggravated. Not a few persons are so sensitized to coffee that very small amounts produce almost immediate ill effects. An eminent New York physician recently stated to the writer that a teaspoonful of coffee would in his case produce a severe headache in half an hour or less. Many thousands of persons have gotten rid of persistent headaches by discarding coffee and tea. The headache which coffee relieves temporarily, is one of the results of the coffee habit and disappears when the drug is definitely discarded.

Copious water drinking (3 to 4 pints daily) is highly important to aid in elimination of toxins.

MENTAL DISEASE

We quote from a competent medical author as follows:

"Intestinal toxemia is a common complication of mental diseases as seen at the Philadelphia Hospital, and occasionally it is the cause or complication of certain cases of epileptiform convulsions."

Modern studies of the causes of mental disease have made clear the fact that in not a small proportion of cases, mental alienation is the result of intestinal toxins acting upon a peculiarly susceptible nervous system. Constipation and toxemia lead to insomnia and depression and in time the mental equilibrium is broken down. Change of flora and the laxative and antitoxic diets are potent means for loosing the shackles of mental disease; and it is hoped that at no distant day, tens of thousands of mental sufferers who are now immured behind asylum bars may be set free by the application of enlightened physiologic measures which at present the State fails to supply.

In some cases insanity has been traced to the coffee habit. Williams, of Edinburgh, reports a case of mental disease in which a woman suffered from frequent attacks of *angoisse*. The attacks stopped entirely when she ceased taking three grains of caffein daily, which she had continued for several months. When it is recalled that a single cup of "good coffee" contains four grains of caffein, according to Dr. Wiley, it will not appear surprising that mental disturbance sometimes results from the long continued use of tea and coffee, often in immoderate quantities.

Dementia praecox has been definitely shown to be, in certain cases, at least, the result of chronic intestinal toxemia. Foul stools and constipation are normally present. The writer has seen very marked improvement in numerous cases of this disease as the result of a change of flora followed by strict adherence to an antitoxic dietary, with hydrotherapy and other physiologic measures.

Much better results have been obtained at the Battle Creek Sanitarium in the treatment of many cases of *manic-depressive* or *melancholia*. The loss of appetite, insomnia, depression, and mental inefficiency are all directly traceable to the disordering influence of intestinal toxins, the suppression of which by changing the intestinal flora and accustoming the patient to an antitoxic and laxative diet of such character as to secure three or four bowel movements daily, has been attended by the happiest results. If these simple measures could be introduced into all our state hospitals for the insane, the result would be a notable and rapid lessening of the insane population of the country, and such a setting free of minds in bondage to disease as would remind the world of the days when miracles were wrought and demons cast out.

In certain forms of paresis, intestinal toxemia plays an active part and hence the fruit regimen and other methods for changing the flora and the antitoxic and laxative diet are measures of essential importance. Even in paresis due to syphilitic infection, the added burden of intestinal toxins is a decided handicap to the curative efforts of the body forces and an obstacle to therapeutic success in the use of salvarsan and other specific remedies that may be readily and advantageously removed by the use of the proper dietetic measures.

In cases in which food is refused, tube feeding, especially feeding by means of the nasal tube, becomes a most valuable and necessary means of keeping up and improving the patient's nutrition. The liquid foods prescribed for duodenal ulcer are appropriate. Malt sugar and milk sugar are especially useful and should be freely used. Malt sugar is the most readily assimilable of foods and milk sugar is one of the most valuable of all means of combating intestinal toxemia, as has been elsewhere shown (pp. 148, 559). Cultures of *B. Acidophilus* should be freely used to aid in restoring the normal intestinal flora and the suppression of putrefactions.

Water drinking should have especial attention. The perversion of the natural instincts often met in the insane leads often to the neglect by the patient to take water in anything like the proper amount. Often, the sense of thirst appears to be lost. Water should be given systematically. A glassful every hour is not too much for the average patient suffering from mental alienation. Fruit juices of any sort may be advantageously added.

EPILEPSY

The most important points in the feeding of epileptics are the elimination of meats, meat extracts and broths, and the disuse of salt.

The late Doctor Combe, of Switzerland, was one of the first to call attention to the injurious effects of salt in epilepsy. He reported very remarkable results from the saltless regimen.

Another French physician, Dr. Miralliè, has more recently made a study of this method, and claims it to be highly valuable.

"Miralliè insists that salt should be discarded absolutely, as also tea, coffee and alcohol. Then the doses of bromides can be materially reduced, and such improvement may then be realized that it amounts to an actual cure. He gives a moderate dose of bromide every day, without interruption. When his patients go thus two or three years without a seizure, he reduces the dose of bromide, but emphasizes that absolute abstention from salt is the main thing. In his first series of 181 cases, only 83 followed his instructions. At that time he ordered merely restriction of salt. In 12 cases the results were negative; in 18 there was improvement and 53 had no further seizures. Since 1912, 52 of the later series of 133 cases followed instructions, and 31 have had no further seizures and 18 have been much improved; more or less benefit has been realized in all but 3 cases. Of 10 men in one institution, all were improved and 5 apparently cured, as also 9 of the 12 women, all showing marked improvement. The youngest of the clinically cured was 7, the oldest 63 years of age. The seizures in one case had been frequent from the age of 7 to 37, but there have been none since this treatment was instituted. The best results were realized in families in which the mother did the cooking, and she was able thus to keep all salt out of the bread, the butter, etc. When this was left to servants, the salt was not banished so rigorously. Full success was realized only in the cases with absolute abstention from salt, tea, coffee and alcohol. * * * * * The benefit was prompter and more pronounced in persons who had previously used much salt. The other symptoms of epilepsy were not modified so early as the actual seizures. The diet, except for salt and stimulants, can be varied and liberal, but must be served entirely without salt. The failures were always in wealthy homes."

Epileptics nearly always have an inveterate tendency to overeat. In many cases, they are also very fond of meats and have a craving for salt. All of these faults must be corrected. Meats must be discarded entirely. In cases in which convulsions occur frequently, the patient should be placed upon a strict saltless diet (p. 447). Special attention should be given to changing the intestinal flora (p. 552), and keeping the bowels freely open by the liberal use of bran, greens and paraffin oil. Washing the colon thoroughly with the enema daily should be practiced as a routine measure in cases in which other methods fail to eliminate the putrid character of the stools. The epileptic should be taught to chew well and to eat sparingly. The food should be simple and rather bland to avoid temptation to overeating. Vegetables like potatoes, turnips, carrots and beets properly cooked, should largely take the place of breadstuffs.

It is now generally recognized that a strict antitoxic diet or lacto-vegetarian diet is one of the most efficient means of controlling this disease. The attacks gradually become less and less frequent until they finally disappear. So long as the kidneys continue to act efficiently, there is little danger of an attack. It has been noted that just before an attack, the proportion of urea diminishes to half or two-thirds the normal. The reduction of proteins to the lowest practical level is unquestionably one of the most efficient means of controlling this malady.

That toxins in the body fluids play a leading part in this disease has been clearly shown by several observers. Some years ago the writer had under observation the case of a young woman who had frequent epileptic attacks, sometimes remaining in a *status epilepticus* for two or three days. A study of the toxicity of the urine by Bouchard's method of determining the urotoxic coefficient, showed a notable lessening of toxicity during the height of the attack and a remarkable increase as it was passing off. Evidently a highly antitoxic diet and copious water drinking are clearly indicated in this disease, together with the elimination of salt from the dietary, and conscientious following of the biologic life. The patient referred to was greatly helped by these measures though not wholly cured.

Great claims have been made for fasting as a cure of epilepsy. All the benefits derived from fasting may be secured by a protein fast; that is, by reducing the protein to a minimum or even excluding it from the dietary for a few days. It is indeed much safer and more rational to put the patient on a carbohydiate dietary (p.572) for a week or two than to require an absolute fast (p. 590).

Good results have followed the operations of appendicostomy and removal of a part of the colon; but there is good reason to believe that the benefit following these operations was the result of a lessening of the toxemia from putrefactive processes in the colon, and that the same relief of symptoms may be secured by a thorough change of the intestinal flora (p. 552) and persistent adherence to the antitoxic regimen. The writer has seen many epileptics greatly benefited by these dietetic measures and not a few cures. In the epileptic ward of a large insane asylum, the adoption of a fleshless diet diminished the number of "attacks" fully one-half.

HYSTERIA

This condition requires no specific dietary other than to avoid the use of nerve irritating and stimulating foods and condiments and to increase the activity of the colon by a highly laxative diet (p.580). Tea, coffee, mustard, pepper, pepper-sauce, vinegar, pickles, much salt, broths and meat extracts, as well as meats of all kinds must be discarded. For emaciated patients, the milk regimen for two or three weeks often secures good results. The milk regimen should be introduced by three or four days of fruit regimen to get the bowels active, eliminate the fetor of the stools, and to create an appetite. A laxative diet is especially indicated. The amount of roughage, bran, greens, and fresh vegetables should be increased until the bowels are made to move three times daily. The enema should be employed in cases in which diet alone is insufficient. Change of the intestinal flora is of first importance.

NEURASTHENIA

Neurasthenia is not in itself a disease but is rather a symptom of disease. It may have for its foundation various morbid conditions, but the most common of all is intestinal toxemia. The writer has maintained this view of the nature of this disease for many years. It is also held by many eminent French physicians. M. Lepine, of Paris, holds that neurasthenia is usually due to autointoxication. The source of the toxins, according to Lepine, is intestinal putrefactions. He finds that the symptoms of exhaustion and neurasthenia disappear quickly when the eliminative organs are made active, and especially when the patient is placed upon an antitoxic dietary by the elimination of flesh foods or the so-called lacto-vegetarian regimen. Consequently, the proper dietetic measures are the fruit regimen to clear the tongue and render the stools non-putrid, followed by the milk regimen for two or three weeks if the patient is emaciated. This course should be repeated until the flora is thoroughly changed, the tongue clean, and breath and stools no longer foul.

After a sufficient gain of flesh has been secured, the patient should follow permanently the antitoxic dietary, taking care to include in the bill of fare for every meal a sufficient amount of roughage to secure three bowel movements daily. This method the writer has followed with much success in the treatment of many hundreds of neurasthenics.

The diet must also include a considerable amount of greenstuffs or uncooked food to supply daily an adequate amount of vitamins, a lack of which is often a cause of the neurasthenic symptoms.

SITOPHOBIA

Sitophobia is the term applied to a condition in which there is a morbid fear or aversion of food. The patient fancies that some particular food, ordinarily perfectly innocuous, is certain to do him harm, and as a result the food, when eaten, through the patient's perverse mental attitude, apparently does disagree, producing various digestive and other disturbances. A person who has been made sick by some particular article, even though it may be something of which he has previously been very fond, is very likely to develop a sitophobia for the article in question.

The gravity of this condition depends upon the extent of the list of foodstuffs which are tabooed by the disease. If the patient has an aversion to all food, the situation may be very serious. The use of the nasal or duodenal feeding tube may be necessary to prevent starvation. When only one or two articles are involved, wholesome, agreeable equivalents may be substituted. Not infrequently the patient may be cajoled out of his morbid mental state. In other cases suggestion or other careful psychic treatment is required.

These patients are usually neurasthenic. Indeed, sitophobia is really a neurasthenic symptom. There are nearly always present marked symtoms of intestinal toxemia and colitis. The flora must be changed, and the bowels made to move three times a day. In some cases, the patient's aversion is due to sensitivity rather than to a morbid psychology.

NEURALGIA—NEURITIS

Pains to which the terms neuralgia, neuritis, sciatica, etc., are commonly applied, are in general due to toxins. The patient requires an antitoxic and laxative dietary. Frequent bowel movements, at least three times a day, are necessary to keep the body free from the toxins with which it has long been flooded. In many cases, there is incompetency of the ileocecal valve, which permits the reflux of putrefying material into the small intestine, where it is rapidly absorbed (p. 680). Change of the intestinal flora is essential (p. 552).

Genuine neuritis, or inflammation of a nerve, is usually the result of traumatism or of a specific infection. The dietary required is the same as that indicated when fever is present, that is, antitoxic and laxative.

VAGATONIA

This is a condition in which the autonomic nervous system is abnormally irritable, as indicated by a tendency to excessive contraction of the pylorus, spastic contraction of the colon and sometimes of the anal muscle. Diet alone is not sufficient in these cases. Rest, sedative baths, changing the intestinal flora, out-of-door life, quiet surroundings, relief from worry, and general reconstructive measures are essential. The diet should be unstimulating. Meats must be discarded. Fruits and green vegetables should be given in great abundance to alkalinize and enrich the blood, and farinaceous foods to increase adipose tissue which is nearly always deficient. The antitoxic (p. 568) and laxative (p. 580) diets are indicated.

This rather vaguely defined condition is supposed to be present in cases of hyperacidity, spasm of the pylorus and gastric hypersecretion, conditions which may be complicated with gastric or duodenal ulcer, or disease of the gall-bladder or other lesions. The diet must then be modified to suit other conditions known to be present, as shown by the X-ray or other means. In general, it should be bland and unstimulating and yet should include a suitable amount of roughage to stimulate intestinal activity, for constipation is practically always present in these conditions. The colon is often spastic and there is generally dilation of the cecum and incompetency of the ileocecal valve as a result of the long-continued overdistension of the large intestine.

Copious drinking of hot water is highly beneficial in most cases of this sort. As soon as the first symptoms of pain appears a tumberful of hot water should be swallowed. The temperature of the water should not be more than 105° F. The hot water drinking may be repeated if the pain recurs. In cases in which the pain appears three or four hours after eating, a copious draught of hot water, two to three glasses, will often afford complete relief by diluting the gastric contents and relaxing the pyloric spasm. The good effects of the hot water drinking are encouraged by lying upon the right side for a few minutes after the water has been swallowed. A hot bag over the stomach, either with or without the abdominal bandage, is helpful in these cases, as is also a large hot enema in cases in which the pain is accompanied by distention of the colon (3 or 4 pints). In cases in which hot water drinking does not afford relief, bland food may be taken in small quantity. The best food for this purpose is rice jelly or a smooth rice gruel, taken warm, with the addition of a little unsalted butter or sweet cream. A tablespoonful to a cupful of bland food will often cause complete relief from pain by stopping the violent contractions of the stomach which accompany, and cause the so-called hunger pain. In cases in which the pain occurs in the night, it is well for the patient to have a little food by his bed to take at once when the pain occurs, as the pain is much more easily relieved if food or hot water is taken at once when the distress first makes its appearance, instead of waiting until it becomes unbearable.

Since this condition is generally associated with intestinal toxemia and colitis, a change of intestinal flora (p. 552), and treatment for colitis (p. 637), are essential.

DIET IN SEASICKNESS—CARSICKNESS

The writer once asked an intelligent steward on a big ocean liner what he thought was the cause of seasickness. He replied at once: "It is because they all eats too much. They just goes down into the saloon and stuffs themselves with all sorts of vittles and then when the ship rolls a little they heaves it all up. Why, there's the captain. He's been to sea more than twenty years, and yet he gets seasick every time the water is a little rough. He eats plum puddin' and all sorts of rich things so of course he is sick. I don't eat them fixin's and I am never sick; but I would get sick mighty quick if I ate like the captain does."

While diet may not be the dominating factor in seasickness and carsickness, it nevertheless is important. Constipation. overeating, and especially the eating of rich food, meats and fats, greatly increase the liability to seasickness. If one is about to take a voyage, he should take care to have his bowels in thoroughly good condition before embarking; the tongue should be clean and the breath sweet. He should be free from any symptom of intestinal toxemia. Such a person, by the exercise of a little care, is not likely to suffer from seasickness. A highly susceptible person may find it necessary at first to remain quiet in his berth during very stormy weather, but he may not suffer from nausea, and by keeping his cabin well ventilated and maintaining a horizontal position, he will have no serious discomfort. The diet in the meantime should be spare, consisting of plainly cooked vegetables, cereals and fruits, with an abundance of bran and other roughage. Meats of all kinds and even eggs, must be avoided. Buttermilk is preferable to sweet milk. Take fats sparingly.

MYASTHENIA

The dietary of myasthenia is the same as that suggested for neurasthenia (p. 750).

The inability of these patients to take much exercise renders a liberal use of bran or agar and paraffin oil essential to promote intestinal activity. The protein intake should be small and fat should be used rather sparingly. A liberal quantity of perfectly sweet butter and yeast extraet (Savita) should be used to insure a good supply of vitamins.

Greens in abundant quantity should constitute a part of each day's bill of fare.

Water should be taken to the extent of two to three quarts daily. The intestinal flora should be changed and kept changed by the antitoxic and laxative diet (pages 568, 580).

In cases with marked emaciation, the milk regimen for two or three weeks is indicated. Care should be taken to make the diet supply an adequate amount of vitamins of all sorts and also food lime and iron.

HERPES ZOSTER

In severe cases, especially when the disease is accompanied by fever and infection involving the central nervous system, a fever diet should be taken for several days (p. 575). Agar or bran with paraffin oil should be administered to move the bowels. If the tongue is foul, the intestinal flora should be changed by means of the fruit regimen with milk sugar and cultures of *B. Acidophilus.* After the fever has disappeared, the antitoxic and laxative diet should be employed (pages 568, 580).

MYELITIS

In this disease, the body is laboring under the influence of a toxicant, the seat of the attack being the spinal cord. This fact has led some authorities to suppose that special attention to diet is a matter of no consequence. It is evident, however, that any measure which tends to decrease or diminish the amount of toxins with which the body has to deal must be important in its relation to this condition. Hence, the dietary should be such as to lighten the burden of the liver, kidneys and other poison-eliminating organs, and thus raise the vital resistance, and so aid the body in its battle with disease.

A foul breath and coated tongue are a clear indication for a change of the intestinal flora by means of the fruit regimen and milk sugar feeding.

If there is a continuous rise of temperature, the fever diet is indicated. When the febrile action ceases, the antitoxic and laxative diet must be employed.

The necessity for copious water drinking to the extent of three or four quarts daily should not be overlooked.

TIC-DOULOUREUX

The diet in this disease should be the same as indicated for neuralgia and neuritis (p. 752).

DIET IN DISORDERS OF THE GENITO-URINARY ORGANS

DIET IN DISEASES OF THE KIDNEYS

The kidneys eliminate two-thirds of the tissue wastes. Each one of the four million renal cells produces about one-fourth of an ounce of urine in a life-time of sixty years, or four drops in one year. This delicate machinery is easily damaged when compelled to eliminate poisons unusual in character or amount; hence, the injury done by typhoid, scarlet fever and other infectious diseases, and by smoking and other drug habits, the use of tea and coffee and of irritating condiments.

The chief aim of diet should be to lessen the intake of toxins and the production of toxins in the body. The first object may be accomplished by suppressing drug habits of all sorts, including the use of laxative drugs, patent medicines, tonics, and soporifics or sleep-producing drugs, as well as irritating condiments, alcohol, tea, coffee, tobacco, meat, meat extracts, broths and vegetables containing considerable quantities of oxalic acid, such as pieplant and sorrel.

Meats of all kinds and meat products should be avoided because meat eating almost inevitably leads to an excessively high protein intake, which necessarily imposes extra and more or less damaging overwork upon the kidneys. Folin has shown that all the protein eaten beyond a small amount required for repair of the tissues, which is never more than two ounces per diem, generally less, is at once converted into urea and eliminated through the kidneys as soon as possible; that is, surplus protein is treated like tissue waste, rendering the body no service, but laying an extra burden on the kidneys.

Newburgh found that rabbits fed on egg white, casein and soy beans for some time as their chief diet, developed nephritis, or Bright's disease.

There can be no doubt that the excessive use of flesh foods is one of the chief causes of the very rapid increase of deaths from Bright's disease in this country and other civilized lands. This has been noted particularly during the last 20 or 30 years, during which time the consumption of meat has greatly increased.

Modern methods of examination of the blood have attained such a degree of accuracy that the influence of diet can now be very definitely determined. Myers has recently shown that in cases of Bright's disease in which the amount of urea in the blood is greatly increased, the urea content may be notably decreased by a low protein diet. The retention of urea in the blood also occurs in pneumonia, in cases of intestinal obstruction, in syphilis and other diseases.

The use of so small an amount as a single small beefsteak, which would double the work normally required of the kidneys, might be a matter of serious moment when these organs are crippled by disease. Certainly, the constant aim should not be to tax the kidneys to the limit of tolerance, but to diminish the work required of them to the lowest minimum.

Game, cold storage meats and such putrid foodstuffs as limburger cheese are so highly injurious in renal disease that in cases in which the renal efficiency is considerably reduced, a single meal of such food may be sufficient to overwhelm the crippled organs completely and produce a fatal uremia. Many a Christmas, New Year's or Thanksgiving feast has been the introduction to a tragedy of this sort.

Meat extracts, animal broths and bouillon are especially harmful. In an interesting paper on the treatment of Bright's disease, Sapelier, an eminent French physician of Nanterre (*Bulletin General de Therapeutique*), in prescribing the dietetic regimen suited to patients suffering from this disease, absolutely prohibits the use of bouillon and all juices and extracts of meat, remarking of bouillon that it is a "*veritable solution of ptomaines.*"

Smoking is particularly injurious to the kidneys, nicotine acting as an irritant to these organs. Gy of Paris has shown by experiments upon animals that the effects of the poisons of tobacco smoke is to cause degeneration of the kidney cells. Doctors who permit their patients to smoke moderately simply say to them: "You may damage yourself a little but do not do yourself as much harm as you might." The late eminent Professor Lauder Brunton maintained that in order to be benefited by renouncing the use of tobacco, the smoker must abandon the habit *in toto,* so that the last trace of nicotine may be eliminated from the body in order to give the recuperative forces an opportunity to rally and so far as possible repair the damage done. This agrees with the writer's experience.

Doctors who prohibit smoking to their nephritic patients do not in so doing expect to effect a cure of the disease but only to postpone the patient's funeral. A longer and more certain postponement would certainly have been possible if the smoking had been prohibited earlier, before the appearance of the kidney disease; in other words, prevention by the avoidance of poison habits is a far more effective means of combating disease of the kidneys and other grave maladies than abstaining after the mischief has been done.

Condiments of all sorts contain essential oils which are chiefly eliminated through the kidneys, and are objectionable because of their irritating properties. Chloride of sodium should be used very sparingly, and in cases in which a dropsical condition exists, a salt-free diet should be employed. Tea and coffee, cocoa and chocolate are objectionable for the same reason as meat and meat broths. A single cup of coffee contains on an average three grains of caffein, which is practically identical with uric acid. When coffee is taken, the uric acid of the urine is increased (Mendel). Three cups of coffee daily more than double the amount of work normally required of the kidneys in the elimination of uric acid. The toxic element of cocoa and chocolate is theobromine, an alkaloid very closely related to caffein, which produces, when taken into the body, essentially the same effects as would be produced by an intake of uric acid.

It is important to remember in the treatment of chronic Bright's disease that every patient suffering from this malady has not only a diseased condition of the kidneys but also of the heart and blood vessels. The affection of the heart is in many cases even more immediately dangerous than the changes in the kidney. In these cases care must be taken to avoid administering too large quantities of fluids, since the weakened heart may be overloaded and dilatation may occur. When the heart affection is serious and there is a tendency to dropsical accumulation the amount of fluids should be limited to about three and one-half pints in persons of average size. The food taken may contain a pint and a half of water in addition to that taken as fluid. The amount of urine should be about equal to that of the fluid taken as such. Once a week the tissues should be flushed by doubling the intake of fluid. This is important to prevent accumulation of tissue wastes.

The writer is quite in accord with the dictum of Doctor

Vaughan of the University of Michigan, who holds that in Bright's disease the blood stream carries to the kidneys toxins which give rise to degenerative changes. To suppress these toxins, Vaughan forbids all flesh food and commends a diet consisting largely of potatoes, green vegetables, fresh fruits, cream and butter, and cereals in moderation.

It is perfectly true, as Vaughan suggests, that after a few weeks patients lose all desire for meat and eggs. This is quite natural because of the fact that the appetite for a high protein diet is an artificial one. The appetite for meat quickly falls away for the reason that man is not naturally a meat eater. Vaughan affirms that even a hard working man can easily live on a diet from which both eggs and meat are excluded.

As Vaughan observes, "The chief value of vegetarian food is that it is a low protein diet, containing less extractives and purin bases than the ordinary mixed diet." It is for this reason that it is to be recommended not only for persons who suffer from Bright's disease but for those who do not wish to become the victims of Bright's disease and wish to keep their kidneys intact to a ripe old age. Sooner or later these delicate and essential mechanisms fail through the development of senile changes. Why wait until the catastrophe comes? Wise forethought well suggests that prophylaxis is better than cure, but in the case of Bright's disease the damage is irreparable and cure impossible. Prevention is the proper thing. Hence the advantage of the biologic diet.

Special care should be taken to avoid the eating of raw or insufficiently cooked white of egg. Egg albumen in this form is almost wholly indigestible and greatly promotes putrefactive changes in the colon. If eggs are eaten, it is best to reject the whites for the reason that egg albumin seems to be less readily appropriated in cases of nephritis than most other forms of protein.

The intake of protein by a person suffering from Bright's disease should not be more than one calory per pound of body weight.

Care should be taken in making up the bill of fare of a nephritic to see that the base or alkaline elements of the food are strongly predominant (p. 184). This will not only require the elimination of all flesh foods but also decided restriction of cereals, which should never be made the staple dietary in cases of nephritic disease for the reason that their exclusive or dominant use tends to diminsh the alkalinity of the blood and tissue fluids. Potatoes and other vegetables should largely take the place of cereals.

The use of mineral waters is to be avoided in nephritis for the same reason that medication of all sorts is interdicted. The ingredients of mineral waters, like other drugs, only add to the burden required of the kidneys and thus hasten the time when their margin of safety will be wholly consumed and the kidney will no longer be able to keep the blood free from toxins and these noxious elements will be permitted to accumulate to such a degree that uremia will supervene and death occur.

In cases of renal sclerosis, which accompanies arteriosclerosis or cardiovascular-renal disease, it is sometimes necessary to limit the amount of water for periods of one to three days. This measure is especially necessary in cases of general dropsy with dilated heart (See Dry Diet p. 608). In nephritis with dropsy, salt should be wholly excluded from the dietary until the dropsy disappears. It may then be used in very great moderation. The "buttermilk cure" and the "skimmed milk cure" for renal dropsy, first suggested by Karell, are chiefly valuable because of the small amount of liquid and very small amount of salt which they supply. This method really seems to present no advantage which cannot be as well secured by a diet consisting chiefly of fruit juices and fruit purées, (the Fruit Regimen, p. 532), which has advantages over the Karell method in the small amount of protein supplied and the laxative effects secured.

In acute nephritis, the diet of the patient for several days may be largely, or even wholly, confined to fruit juices or sugar water prepared by the addition of two ounces of malt sugar to a pint of water, or in place of malt sugar the sugar of raisins may be used. Soak four ounces of raisins in a pint of water, stew for 20 minutes, pour off the juice and increase to one pint. A pint of raisin juice prepared in this way contains 200 calories of sugar which is ready for immediate absorption. Lactose or milk sugar may also be used.

Von Noorden is a very strong advocate of fruit in renal disease, as is well known by all who have visited his clinics. He says (Von Noorden's "Metabolism"):

"It is the theory of many physicians that nephritic patients should be given a diet poor in proteins (Senator, F. Hirschfelt, Albu, and others). It is said that such a diet puts less strain on the diseased organs. No doubt this is true, for acute nephritis and for the acute relapses of chronic nephritis, as I have emphasized elsewhere. For two years I have been of the opinion that in acute and dangerous cases *no nitrogen should be given in the food.* I have given nothing but sugar water and fruit juice for from three to eight days at a stretch (often 200 to 300 grams of sugar daily). It was my impression that this form of treatment was very useful, and that uremic symptoms were obviated, or if already present, were removed.

"In acute nephritis on the one hand, and in the acute inflammatory exacerbations of chronic renal disease, a large protein intake undoubtedly exercises an injurious effect on the albuminuria. Even a milk diet is too rich in protein for this form of kidney trouble. When the inflammation is at its worst I give nothing but sugar-water (about 150 to 200 grams daily) and strained rice broth, with cream or butter added. This regimen reduces the work done by the kidneys to the lowest limit. I add milk to the diet only when the patient begins to be convalescent."

The "fruit regimen" is still more efficient in cases of renal disease than the "fruit diet" of Von Noorden, because of the increased intestinal activity and change of the intestinal flora, which lessens the absorption of toxins and the work of the crippled kidneys.

Bichlorid Nephritis. The urinary suppression induced by this toxic nephritis quickly leads to an accumulation of nitrogenous wastes in the blood. The indication is to place the patient for a few days upon a strictly carbohydrate diet—sugar water by mouth, by enéma, and if necessary, by intravenous injection. It should be given in such quantities as will give the patient twelve to fifteen hundred calories daily. By this means, the patient's strength may be maintained, and the heart action sustained, while the mercury is being eliminated. The patient should receive 3 to 4 pints of water or liquid in twenty-four hours

Diet in Cases in Which One Kidney Has Been Removed.

In cases in which one kidney has been removed, a strict anti-toxic (p. 568) and laxative diet (p. 580) should be carefully adhered to. On a high protein diet the amount of urea excreted by the kidneys is 33 to 37 grams, or an ounce and a quarter. On a heavy meat diet the amou grams, or three and one-third ounces. O the urea output falls to 9 grams, less th ounce.

From these facts it is evident that the eater are compelled to do from two to five tim the elimination of urea as is required of th protein feeder. Since Folin has shown th creted by the kidneys represents surplus pr protein which has never been assimilated been utilized for tissue-building, it will rea high protein diet is one of the most efficient the kidneys may be prematurely worn out a viated. By means of careful dieting, the w may be reduced to one-half or even one-third t ordinary dietary and thus, when one kidney life and useful activity may be prolonge whereas, without the relief afforded by c single kidney would soon be worn out and brought to an untimely end.

ALBUMINURIA

When albuminuria occurs in connection order of some sort, such as epilepsy or ap should be placed at once upon a low protei tary. When albumin appears in acute Brigh should be withheld for a short time except fr sugar. In acute nephritis occurring as a com fever and in the acute albuminurea of pr dietary should be adopted for a few days un the disease is controlled (pp. 572, 447).

OXALURIA

Besides eliminating from the diet foods meats of all sorts should be discarded and sp taken to avoid the use of hard water. An an should be permanently adopted. Pieplant, t be scrupulously avoided and greens, especiall parboiled.

DIET IN ABSCESS OF THE KIDNEY

When the kidney is the seat of abscess or of infection with rise of temperature, the dietetic indications are the same as in fever (p. 575). It is especially important to keep the bowels active by a laxative diet (p. 580) and to change the flora (p. 552), so as to lessen the work of the kidneys as much as possible.

GRAVEL AND STONE

This condition is most often due to faulty metabolism. The alkalinity of the body fluids is diminished, and there is excessive formation of oxalic acid and other organic acids which, when present in concentrated urine, lead to the deposit of insoluble salts in the kidney or bladder. A diet consisting chiefly of cereals and meats with a small intake of water strongly predisposes to this condition. It only requires the absorption of a small quantity of water from such concentrated urine to cause the deposit of a minute amount of solids in the urinary tract, and when this is done, the formation of a calculus has begun. It has been noticed that calculi do not form in domestic animals when they are allowed to graze at pasture in the summer or are fed liberally on potatoes, ensilage, turnips, pumpkins, and other foods rich in alkaline salts and containing an abundance of water. Hard water tends to increase the concentration of the urine and so encourages the formation of calculi, which accounts for the frequent occurrence of these concretions in both men and animals in limestone regions.

Many eminent authorities, including Klemperer. insist strongly that all foods containing uric acid or oxalic acid must be strictly prohibited. This interdiction includes not only meats of all kinds but tea, coffee, and cocoa as well. Also sorrel, rhubarb, and even spinach and beans, although beans and spinach may be rendered wholesome by parboiling.

Cereals should be eaten sparingly and potatoes should be used largely instead of bread because of the alkaline salts which they supply. Fruits should be freely used for the same reason. Muskmelons are particularly beneficial (p. 293).

When magnesia is present in water in considerable quantity, the tendency to formation of calculi is increased because of the readiness with which magnesia is precipitated in the presence of ammonia which is developed in the bladder in cases of catarrhal inflammation of the mucous membrane, and is likely to occur as the result of infection with the colon bacillus and other microorganisms.

Roberts, an authority of high standing, holds that urinary calculus, that is, stone in the bladder or kidney, is due to a deficiency of the diet in the alkaline salts, soda and potash, found in potatoes and other vegetables. He notes that these alkalies are deficient in the blood and the urine in all cases of gravel, and also observes that calculus rarely affects children in well-to-do families but is quite common among the poor, who suffer most from the lack of the alkaline salts supplied by green vegetables. It is not at all likely that stones when they are once formed in either the kidney or the bladder can be entirely dissolved in this way, but in case of renal calculi in the ureter, the free use of potatoes with copious water drinking may diminish the size of the stone sufficiently to dislodge it and thus lead to its expulsion. The writer has seen this result in several cases. It is clearly evident, then, that persons who live in a hard water district should avoid the too free use of cereals and by the free use of potatoes and other fresh vegetables and fruits seek to alkalinize the tissues and to maintain a high content of soda and potash in the tissue fluids.

Intestinal asepsis is important in these cases because of the more or less crippled condition of the kidneys. The flora should be changed and the colon kept free from putrefaction by a laxative and antitoxic diet. Potatoes should be largely used in place of bread and cereals. This is especially important as a means of preventing stone in regions where the water is very hard.

INFLAMMATION OF THE PROSTATE GLAND

The indications are the same as for disease of the kidneys and cystitis. Meats and condiments tend to increase the irritation of the prostate. Constipation greatly aggravates this disease, and on this account the dietary should be highly laxative, containing large amounts of bran, at least half an ounce to an ounce a day with greens and other roughage and a sufficient amount of paraffin oil to secure three full and soft bowel movements daily. The enema should be used daily if necessary. Laxatives should be avoided.

DIET IN URETHRITIS—GONORRHEA

Condiments of every description, and especially asparagus, rhubarb and other foodstuffs which contain irritating substances which find their way out of the body through the kidneys must be avoided. Water should be taken very freely, at least a glassful every hour, to render the urine neutral. Beer, ale and other alcoholic liquors and tea and coffee should be avoided, also meat dishes, pickles and other unwholesome foodstuffs of all sorts. The diet should be essentially the same as in cases of calculus.

CYSTITIS

In cystitis the indications are the same as in urethritis. By copious water drinking the urine may be diluted so that the irritation produced by contact of this excretion with the inflammed mucous membrane of the bladder will be lessened. When urination is frequent and painful, copious water drinking is especially important. A glassful every hour is not too great a quantity. The diet should be laxative and antitoxic (pp. 580, 568). When the urine is slightly acid, fruits and fruit juices should be freely used with the exception of prunes, plums, grapes and cranberries. Potatoes should be used instead of cereals.

DIET IN DISEASES OF WOMEN

While there is no specific diet indicated for the disorders peculiar to women in general, it is to be noted that women are, on account of their sedentary life, much more subject to constipation than are men. It may be said, also, that many of the distresses from which women suffer should be attributed to the intestinal toxemia, colitis and other colonic infections, which are the result of constipation, rather than to disease of the sex organs. This is especially true of the headaches, backaches, lack of appetite, lassitude and general lowered vitality which are most often charged to disease of the pelvic organs, and various local affections, such as leucorrhoea, cervicitis (erosion), menstrual pains and irregularities, and urinary affections, which are in many cases either a direct or indirect result of constipation.

In general it may be said that practically all civilized women need to adopt more biologic habits in diet. Tea and coffee must be given up. The confections and pastries should be replaced by coarser and simpler dishes. Bran should be made a part of every meal. Greens and fresh fruits and vegetables should figure largely in every day's bill of fare. The laxative and antitoxic and blood building dietaries (pages 580, 568, 588), may be safely recommended in nearly all cases. The average American woman is anemic. Milk and greens should take the place of beefsteak. Coarse graham or bran bread should replace white bread and soda biscuits. More and better blood acquired by eating and assimilating appropriate food in ample quantity will do more to restore an invalid woman to health than all the drug tonics and widely exploited nostrums to be found in the drug shops.

DIET DURING PREGNANCY

The expectant mother needs to be well fed for the sake of her unborn child as well as for her own welfare. The intake of food must be increased, and nature has provided for this by giving to woman a stomach, liver, and other digestive and eliminative organs notably larger than in man. The dietary of the expectant mother should include especially foods rich in lime, iron, vitamins and roughage. The body of an infant weighing 6 lbs. contains more than an ounce of lime, all of which must be stored up during the months of gestation, and most of it within the last three months. This would require an average daily addition of five grains of lime, or one-third the ordinary ration of 15 grains. This extra amount of lime will be furnished by three ounces of spinach and 6 ounces of milk.

Again, the infant's body contains about 10 grains of iron, nearly half of which is stored in its liver for use in blood-making during the nursing period, necessary because of the fact that milk contains only a very small percentage of iron. It is thus evident that the pregnant mother should take care to make her daily menus rich in food iron. The deficiency cannot be made up by swallowing iron pills or "tonics" or drugs of any sort. The iron must be furnished by suitable foodstuffs. Fortunately, nature supplies an abundance of iron in greens of many sorts (Table p. 285). Six ounces of spinach added to a varied diet of fruits, whole grain products and fresh vegetables will supply the full amount of iron required. Numerous other foodstuffs are also rich in iron, even richer than is beefsteak, while affording a superior kind of food iron (p. 170). Malt sugar, molasses, dates, figs and raisins should be substituted for cane sugar. Malted nuts may be substituted for milk. Lentils and nuts should be freely used.

Vitamins are needed to promote growth. The ordinary diet of tea, toast, bacon, rice, white bread, potatoes, pastry and sweets is almost wholly lacking in all three of the food essentials mentioned.

The expectant mother should take at least a full quart of milk daily. The diet should be substantial. Pastry and tidbits as well as tea, coffee and condiments must be strictly avoided. Flesh foods are not needed, and are likely to do much harm. The same is true of meat extracts and bouillons. The flora should be changed and kept changed (p. 552), so as to lighten the work of the kidneys as much as possible. Especial attention should be given to this during the last weeks of pregnancy as a preparation for the final ordeal. By this means some of the greatest perils of childbearing may be almost certainly avoided.

The intake of food by the expectant mother near time for confinement, should be at least ten per cent greater than that of the non-pregnant woman under like conditions. A tendency to overfatness will demand restriction to actual requirements.

Free water drinking is likewise important as an aid to free elimination. The water intake, aside from the water of the food, should be at least three or four pints daily.

The notion exploited by certain writers some years ago that child birth might be made easier by use of a diet deficient in lime, has been shown to be absolutely without foundation. The idea was based upon the supposition that if the food contained little lime the bones of the infant would also contain less lime, and so would be less rigid and more easily molded to the narrow outlines of the pelvic outlet. The scheme fails for the reason that nature will not be thwarted. She insists on putting into the baby's bones all the lime they need. If the food is deficient in lime she takes it from the bones of the mother. This has been amply proven by experiments on animals.

Especial attention must be given to the bowels. By three daily bowel movements and care to thoroughly empty the colon every day intestinal putrefactions may be suppressed and the danger of serious complications greatly lessened. The expectant mother should adhere closely to an antitoxic and laxative diet (pages 568, 580), and should make free use of bran and paraffin oil and if necessary should resort to the use of the daily enema.

Nuts and nut preparations may be used quite freely with advantage, especially during the last weeks of pregnancy, to encourage a liberal production of milk (Hoobler).

DIET OF THE LYING-IN WOMAN

The lying-in period is one of the most critical in a woman's life experience. By proper feeding, serious dangers may be warded off. In general, the directions already given for the feeding of the expectant mother should be followed by the lying-in woman. During the first two days, the diet should be light, consisting chiefly of ripe fruits, fruit juices, purées of vegetables, oatmeal porridge with bran, buttermilk and baked or mashed potatoes. Spinach is especially indicated. Meats must be wholly excluded and eggs may be omitted with advantage for a few days. Three ounces of milk sugar three times a day for the first four or five days aids in keeping the intestinal flora in good condition. The aim should be to make the diet sufficiently laxative to insure three bowel movements a day without the use of laxative drugs other than paraffin oil with bran or agar. Buttermilk prepared with the *B. acidophilus* ferment or whey cultures of the same is especially to be recommended. Copious water drinking, two or three quarts in twenty-four hours, greatly protects the kidneys by encouraging elimination of toxins.

DIET IN ECLAMPSIA

The colon should be thoroughly emptied by repeated enemas Milk sugar should be given in doses of three ounces three times a day for a few days to change the intestinal flora. It is well, also, to administer enemas containing two or three ounces of milk sugar or malt sugar to the pint of water to suppress intestinal putrefactions. Fasting is a measure of value. It is especially important to suppress proteins, particularly animal proteins. Eggs and meats of all kinds should be carefully suppressed. Fruit juices and purées and sugar water are the only foods permissible. A hot blanket pack followed by vigorous cold towel rubbing is a measure of great importance. It may be repeated two or three times a day.

DIETETIC MANAGEMENT OF FEVERS

The recognition of the fact that in fevers a state of general acidosis exists, has led to a radical change in the general method of dietetic management of this class of maladies. The old plan of starving fever patients was most unwise as it encouraged to a high degree the development of acidosis. Equally objectionable was the gross feeding with meats and miscellaneous foodstuffs advocated forty or fifty years ago when Brand was demonstrating the value of the hydriatic method of treating fevers, especially typhoid fever. Incomplete oxidation and acidosis may result either from excess of food or from starvation.

Probably no other measure can do more for the amelioration of the patient's sufferings and his safeguarding against complications than appropriate regulation of the dietary. The normal functions of food are to supply the body with fuel and with material for tissue repair. Certain foodstuffs, particularly proteins, when supplied in more than the amount needed for repairs, act as stimulants or excitants and cause an enormous and most unprofitable loss of energy, far exceeding in amount that actually devoted to useful work. Carbohydrates are the most economical of foodstuffs, as they require the least expenditure of energy, and give most in return for the energy expended. Malt sugar and the sugars of fruits and fruit juices are the foods *par excellence* for fever cases because of the ease with which they are appropriated and because they are least stimulating and also supply alkaline residues which neutralize the disturbing acids always present and leave behind no toxic residues.

Milk sugar and dextrine or lacto-dextrine are the best carbohydrates for combating the intestinal infection and putrefactions, for the reason that they are slowly absorbed and pass quickly through the small intestine, and so are certain to reach the colon and to arrive there more quickly than other sugars. Lactose and dextrine are the best foods to encourage the growth in the colon of the protective organism, *B. acidophilus,* the natural guardian of the colon against the dangerous putrefactive organisms always present in the colons of adult human beings.

Lactose, or lacto-dextrine, may be used in liberal quantities; that is, eight to ten ounces a day, with marked benefit. Torrey changed the flora of typhoid cases by this means.

Acidophilus-Lactose, a concentrated culture of *B. acidoph-*

ilus with lactose, affords the most efficient means yet found for changing the intestinal flora, that is, for driving out of the colon invading bacteria. This special carbohydrate may be used in typhoid fever as well as other intestinal infections with marked advantage.

In the feeding of fever patients, one of the first considerations is an abundance of water to dilute and carry away the toxins through the kidneys. From four to six quarts of fluid are needed daily, by mouth or per rectum or both.

A second indication is to combat the tendency to emaciation. This is accomplished by rest, control of the temperature, and the liberal feeding of carbohydrates, in the form of cereals, fruits and fruit juices and malt sugar.

On account of the tendency to retention of chlorids in the tissues, salt should be as far as possible eliminated from the diet. Loss of lime, iron and vitamins should be made up by the use of fresh vegetables, greens, and vegetable broths. The liver and kidneys are compelled to do an enormous amount of overwork in fever, in the destruction and elimination of poisons produced by the fever. On this account the greatest care must be taken to avoid adding burdens to these overworked organs, and to lessen their work as much as possible by supplying an abundance of water and by withholding from the patient anything likely to increase renal work. Condiments of all kinds—mustard, pepper, and vinegar—must be strictly prohibited. Alcoholic liquors and tea and coffee are especially damaging because of the poisons which they contain. For this reason, also, meat broths, extracts, beef tea, chicken broth, etc., must be strictly avoided, as well as meats themselves. Because of the special tendency to intestinal putrefaction in cases of fever, all foods which have a tendency to putrefy must be prohibited. This is the reason why not only meats of all kinds, but eggs, must be discarded.

The substitution of malt sugar for cane is important for the reason that this sugar contains much iron, lime and vitamins, not found in cane sugar. Purées and other dishes prepared from dates, figs and raisins should take the place of dishes sweetened with ordinary sugar because of the richness of these fruits in iron (p. 171). Change the intestinal flora with milk sugar or Acidophilus-Lactose (p. 552).

Special attention should be given to the colon in all cases of fever. Even when the bowels are "loose," the colon should be emptied by an enema twice a day in order to insure against fecal accumulation. Except in enteric fevers, bran, agar, mineral oil and laxative foodstuffs should be used in quantities sufficient to insure efficient action of the colon. Even in typhoid there seems to be no good reason why agar and mineral oil may not be used, and even cooked bran when constipation is present.

Foods Which May be Used in Fevers.

All fruit juices, fresh if possible
Apple juice
Orange juice
Lemonade with malt sugar
Watermelon juice
Cantaloupe
Raspberry juice
Pear juice

Fruit soups
Fruit purées
Fresh, ripe fruits
Banana Purée
Soaked prunes
Cereals:
- Rice
- Wheat flakes
- Grape juice

Gruels of oatmeal, corn meal, granola, 20% gluten, rice meal

Malt sugar
Meltose
Nuts:
- Blanched almonds
- Malted nuts
- Almond cream

Fresh vegetables:
- Cucumbers
- Lettuce
- Purées
- Vegetable broths
- Vegetable purées
- Buttermilk
- Nuttolene

Yogurt buttermilk (*B. acidophilus*), Acidophilus-Lactose

Foods to be Avoided in Fevers.

Foods which must be strictly prohibited in fevers are meats of all sorts, fish, flesh, fowls, oysters, etc., eggs, mushrooms, pickles, cheese, condiments, much salt.

Acute Infectious Fevers. The dietetic indications in the several infectious fevers are essentially identical. Fever diet (p. 575), is indicated in all. In scarlet fever and diphtheria, bland foods must be employed when the throat is sore. Rice gruel is especially indicated. In cases of post-diphtheritic paralysis in which the patient is unable to swallow, the food must be administered with a small feeding tube. A laxative and reconstructive diet is indicated as soon as the fever patient is able to eat. If for some days during the height of the disease the patient refuses gruels and similar foods, strength may be maintained by the free use of sugar water. The latter is prepared by adding two ounces of malt sugar or milk to a pint of water. The sugar water may be taken by the stomach or by enema, or both.

Whooping Cough. While the diet in this disease is essentially the same as in other fevers, a special difficulty arises in the fact that the violent coughing often induces vomiting and loss of a large part of a meal which may have just been eaten. Any disturbance of the stomach likewise has a tendency to increase the coughing, so a sort of vicious circle is formed. The food must be appetizing, but bland and lukewarm. If either hot or cold, violent coughing may be induced with vomiting. Gluten gruel, vegetable broths, rice, rice gruel, oatmeal gruel, cream toast, brose and breakfast cereals with bran are foods especially suitable to this condition. When the coughing is violent, the child should be kept in bed for two or three days if necessary until the paroxysms are less intense. The patient should be kept in the open air practically all the time.

Poliomyelitis. The dietetic indications are the same as in typhoid and other fevers.

Other Fevers. The regular fever diet is also indicated in *yellow fever, malarial fever, relapsing fever, sleeping sickness, and plague.*

In foot and mouth disease, rice will be especially grateful to the patient as it is bland and absolutely unirritating and can be swallowed with less distress than almost any other food.

Cholera. During the acute stage of the disease, the patient should take nothing but water or water containing a small proportion of sugar, say an ounce of malt sugar to the pint. Notwithstanding the persistent vomiting the patient should drink copiously. The effect will be to dilute the poisons of the stomach and to wash out infectious material. At the same time large enemas should be administered. Cold rubbing combats shock and promotes the skin circulation. If vomiting and purging continue to an extreme degree, liquids may be introduced by intravenous injection, and it is possible in an extreme case that life may be saved by transfusion of blood, an operation which has now become quite common since the dangers and inconveniences have been practically eliminated by the discovery of a method by which a suitable donor may be selected. The intravenous injection of dextrose is the most efficient method of combating acidosis. Milk sugar with *B. acidophilus* in larger doses should be tried.

Typhoid Fever. This disease presents typical indications for the fever diet. Alcohol, eggs and animal broths, as well as meat and fish should be prohibited in this disease. Rice, strained oatmeal, Granola, toasted flakes of various sorts, zwieback, stewed fruit, fruit juices, and especially purées of greens, potatoes and other vegetables should be given the patient in such quantities as to furnish about 2,000 to 2,500 calories daily. When this is done, the great loss of flesh which often occurs in this disease will not take place, the disease will run a shorter course and convalescence will be more rapid.

Torrey has shown (1915) that by the feeding of 8-10 ounces of milk sugar (900-1100 calories), the intestinal flora of typhoid fever patients may be changed from the ordinary, mixed type with putrefactive flora dominant to an acidophile flora with *B. acidophilus* dominant. Such a change is exceedingly advantageous to the typhoid fever patient by the suppression and absorption of putrefaction products which increase the labor of the kidneys, already enormously overtaxed in dealing with the typhoid toxin, the specific product of the typhoid bacillus. Still more prompt and complete results may be obtained by administering in typhoid fever large doses of milk sugar, with concentrated cultures of the *B. acidophilus.* This method not only changes the intestinal flora but supplies the patient with a considerable amount of nutritive material of exactly the sort needed, and Rettger and Cheplin have demonstrated the efficiency of this measure in changing the flora in several healthy adults.

Milk is not a good routine diet for use in typhoid fever. It often promotes intestinal autointoxication through the retention in the colon of considerable quantities of undigested curds. Whey cultures of *B. acidophilus* are especially valuable in typhoid feeding. Cautley commends whey as a substitute for milk. Milk sugar may be added with advantage, two ounces to the pint. Four to six pints may be taken daily. Malted Nuts, lentil soup, and the fruit soups of the Germans, and Savita are of special value.

Typhus Fever. The dietetic requirements of this disease are the same as those indicated in typhoid. Fruit juices, sugar water, malt or milk sugar, boiled rice, and oatmeal gruel are the most appropriate foods.

Erysipelas. The dietetic indications are the same as in typhoid and other fevers.

Influenza. The diet indications are the same as in pneumonia and typhoid. Alcohol should be avoided as also meat extracts and broths.

Mumps. The diet should be the same as in other infectious fevers. Food is best taken in liquid form and by the aid of a large feeding tube, which minimizes the use of the jaws. The necessary intake of bran or roughage and paraffin oil for lubrication should not be neglected.

Pyemia. The diet should be strictly antitoxic. Fruit juices and sugar water should be used in sufficient quantity to give the patient 16 to 18 ounces of carbohydrate daily. A carbohydrate diet greatly aids in promoting resistance.

Lockjaw. The diet in lockjaw should be the same as that in other febrile diseases. On account of the difficulty in moving the jaws, liquid diet is especially indicated as in mumps. Milk sugar and malt sugar should be freely taken in solution in water or in whey.

PNEUMONIA AND PLEURISY

In lobar pneumonia, bronchial pneumonia and other forms of inflammation of the lung tissue as well as in pleurisy, the fever diet should be employed (see p. 575).

In addition, it should be noted that in inflammation of the lungs, especially in lobar pneumonia, there is a marked tendency to retention of sodium chlorid. Hence, common salt should be omitted from the food until salt appears in the urine. Meat, meat broths and extracts as well as eggs, should be rigorously excluded in this disease. Copious water drinking to the extent of three or four quarts daily is most important.

After the attack is over, the restorative regimen (p. 588), should be employed to aid in the building of blood and tissues and to restore the tissue salts.

In empyema, hay fever and other chronic febrile conditions of the lungs and air passages, the fever diet should be followed closely during periods when there is a rise of temperature, and in the intervals the reconstructive diet should be employed. Milk, cottage cheese, buttermilk, butter, greens, potatoes, rice, fresh fruits and vegetables of all sorts, especially in the form of purées and soups, constitute a suitable diet for cases of this sort.

The bill of fare should be varied from day to day so as to promote appetite, but too many different kinds should not be taken at the same meal. The quantity of food should be 25-50 per cent more than the amount needed for a maintenance ration, so as to secure a gain in flesh until the normal weight has been attained or slightly exceeded.

Malt sugar and malted nuts and other malted preparations are especially useful in promoting flesh-building.

DIET IN CHRONIC INFECTIONS

PULMONARY TUBERCULOSIS

It must be frankly conceded that there is no specific dietary adapted to tuberculosis as in diabetes and in certain other maladies. The important thing is to build up the patient's nutrition to the highest level possible.

The general indications are for a diet rich in fats and carbohydrates, vitamins, iron and lime, and sufficiently bulky to secure three or four bowel movements daily. When necessary, agar as well as bran should be added to the dietary and mineral oil should be taken before and after each meal.

Malt sugar in the form of syrup, combined with olive oil or butter or cream, is perhaps the most efficient of all food combinations in promoting the development of fat. Malt sugar is much better tolerated and more readily absorbed and utilized than any other form of sugar, and it is tolerated in much larger quantities than is cane sugar. Fats when combined with malt sugar, are much more readily tolerated and do not cloy the appetite as they are otherwise likely to do. In equal quantities, malt sugar syrup (Meltose) and butter make a very palatable combination and one which can be taken at every meal and in considerable quantities, and which will rapidly secure a substantial gain in weight.

On a dietary such as is here suggested, a gain of a pound a day is frequently secured, and the weekly gain for a short time may be as much as eight or ten pounds.

It is more than probable that a deficiency of vitamins in the diet encourages the development of pulmonary tuberculosis and other diseases which result from low vital resistance.

In many cases the milk regimen (p. 539), is advantageous. When the tongue is coated and the breath foul, indicating autointoxication, the fruit regimen, (p. 532), should be employed for a few days to change the intestinal flora before starting the milk regimen.

Buttermilk prepared with the *B. acidophilus* may be freely used with great advantage. About three pints of buttermilk a day is required to influence the intestinal flora to a marked extent. Practically every tuberculous patient may be substantially benefited by a change of the intestinal flora. There is no way in which the curative functions of the body can be more efficiently reinforced then by eliminating the poisons arising from the putrefaction of food residues in the colon. By the methods presented elsewhere in this work (p. 552), this may be easily and quickly accomplished.

It is now well known that milk proteins are equal if not superior to meat proteins, and are more easily assimilable. One quart of milk daily will certainly supply to any consumptive all the real value he can possibly receive from the usual daily intake of meat, and in better form, and several quarts may be taken if needed.

The tendency of tuberculous patients to renal disease (86 per cent) is a most weighty reason for lessening intestinal toxins by withholding meats.

Says an authoritative writer in the *Journal of the American Medical Association,* "The favorable course of many cases of pulmonary tuberculosis is interrupted by attacks of intestinal toxemia. The diagnosis of this complication is absolutely necessary for success in the treatment of tuberculosis."

There has been a marked tendency on the part of the majority of those who have given special attention to the treatment of this class of patients to insist upon overfeeding as the most efficient method of combating the wasting disease. Certain specialists have demanded a very high protein diet, which in a few instances comprised not less than one thousand calories of protein per diem, or more than five times as much as the normal requirement according to the standards of Chittenden, Sherman and Folin. Some years ago an institution was started in Germany which undertook to feed the tuberculosis patient on an exclusively flesh diet, and in this instance the diet was not only wholly made up of meat but of raw meat. It is hardly necessary to add that the enterprise was a complete failure, in fact collapsed within six months of the opening.

For many years the writer has urged the employment of a low protein regimen as best adapted to tuberculosis cases. In a paper read before the International Congress on Tuberculosis, October, 1908, the writer pointed out some of the dangers of the high protein regimen in the following paragraphs.

The marked tendency of the tuberculosis patient to loss of flesh and to the development of anemia has naturally directed special attention to the importance of encouraging the fat-building and blood-making processes of the body. But there are other indications which are equally deserving of attention and which should be permitted to influence the dietetic management of these cases. The materials ingested must be metabolized and eliminated as well as digested and absorbed. Incidentally, while undergoing digestion, they may also undergo fermentations and putrefactions which may so change their nature as to render them not only useless as nutrients, but toxic and in the highest degree damaging. Hence the welfare of the liver and other toxin-destroying glands and of the kidneys, poison-eliminating glands, must be considered as well as the need of the organism for an increase of adipose tissue.

A simple increase in the thickness of the panniculus adiposus cannot be of any very great advantage to a man whose body has been invaded by a vast army of tubercle bacilli. Before the infection took place there had been a depreciation in vital resistance, a deterioration of tissue and function which made the invasion possible, and with each advance of the disease, this weakening of the ability of the organism to battle against its foes is increased. Recovery can be secured only by improving the integrity of tissue and function to such a degree that the ability of the organism to combat its assailants will be raised higher than before the invasion occurred.

The average subject of tuberculous infection presents a number of special pathological conditions which must be considered in preparing a therapeutic regimen. Among these may be especially enumerated the following:

1. *Diminished "Alkalinity" of the Blood* (Lawrason Brown).—This signifies diminished vital resistance, diminished efficiency of the blood as a germicide, diminished power to develop immunity, diminished power to repair damaged tissues, diminished power to oxidize wastes. Anything which tends still further to diminish the alkalinity of the blood must be to that degree a hindrance, rather than a help, in the battle of the

organism against the tubercle bacillus. One of the notable and constant effects of a high-protein dietary is to diminish the alkalinity of the blood.

2. *Diminished Hepatic Efficiency*—In consumption the liver is nearly always seriously crippled. Ulldom declares that passive congestion of the liver is found in nearly every case of pulmonary tuberculosis. This is the natural result of diminished respiratory activity, since the venous circulation of the liver is largely influenced by the movements of the chest in respiration. To the evidences of chronic passive congestion of the liver are added, according to Ulldom, many other evidences of a lowered vital state in this organ, among which are amyloid and fatty degeneration, tuberculous infection, and fibrosis or cirrhosis. Ulldom expresses the opinion that fibrosis of the liver is not due to the tubercle bacillus, but to "other etiological factors." Boix and others have shown what these factors may be. According to Boix the toxins formed as a result of putrefactive processes in the intestine are the chief cause of hepatic fibrosis. He was able to produce cirrhosis of the liver in rabbits by mixing with their food cultures of colon bacilli and also by feeding them extracts of feces.

That a high-protein ration, that is, a dietary consisting largely of flesh foods, favors hepatic congestion, is a fact long known to physicians. A diet which encourages intestinal putrefaction and an abundant anaerobic flora in the intestine, must in the highest degree encourage hepatic congestion and various functional and organic changes in the liver, and thereby break down this important defensive barrier and prepare the way for invasion by the tubercle bacilli. It need not, then, be a matter of surprise that Ulldom found in thirty-seven autopsies in cases of pulmonary tuberculosis, a tuberculous condition of the liver in 81 per cent of the cases. Fatty degeneration of the liver was found in 24 per cent of the cases, and in only two cases (5.4 per cent) was the liver found approximately normal; that is, the liver was found diseased in 94.6 per cent of the cases. Arnold reported tuberculosis of the liver as an almost constant finding in pulmonary tuberculosis. Simmons reported tuberculosis of the liver in 78 per cent.

The passive congestion of the liver which naturally results from the overwork of the right heart and the diminished mobility of the chest, together with the special exposure of the liver to infection through the portal circulation and the extra work required of it in metabolizing the excessive nitrogenous waste which accompanies the febrile stage of pulmonary tuberculosis, certainly suggest the importance of guarding the integrity of this vitally important organ in every possible way, and contraindicate a high-protein dietary which imposes exaggerated and unnecessary hepatic work.

3. *Degeneration of the Thyroid Gland.*—Entirely in harmony with the considerations presented above is the interesting fact to which Roger, Garnier, De Quervain, Sarbuch, and others have recently called attention, viz., the occurrence of general sclerosis of the thyroid gland without tuberculous lesions of the gland itself in cases of tuberculosis affecting other parts of the body.

In a case of tuberculosis of the lungs reported by Carnot and Delion, death occurred from tetany, and post-mortem examination showed caseous degeneration of the parathyroids. This condition of the thyroid and parathyroid is attributed to "the effect of the action of the diffusible toxins produced by the tubercle bacilli." It is well known that other toxins, especially those produced by putrefactive changes in the intestine, are capable of producing diseased conditions of the thyroid, the natural result of the overwork of the glands occasioned by excessive saturation of the blood with these toxic substances.

The enormous burden added to the labor of the defensive organs of the body by a high-protein diet, and the great injury which must result when these organs are weakened, is illustrated by what happens when certain toxin-destroying glands are removed from the body or rendered functionally inactive. It is well known, for example, that the removal of the thyroid gland (Breisacher, 1890) of a dog is quickly followed by the death of the animal if it is fed upon a meat diet, while life is prolonged indefinitely and the animal enjoys good health when fed upon a diet of bread and milk. When such a dog is fed upon meat which has been well boiled, it suffers less and lives much longer than when fed upon raw meat, evidently because of the removal of poisonous meat extractives in the boiling. Blum holds that the function of the thyroid gland is to neutralize poisons derived from the putrefaction of albumin in the intestine. Kishi holds that the thyroid destroys a poisonous substance, a nucleoprotein which is formed in the intestine after the ingestion of meat.

These facts are alone sufficient to condemn a high-protein or flesh diet in a disease in which the thyroid gland is already overworked, and in which it is likely to be seriously crippled. Is it not possible, indeed, that the effect of such a diet in a case of pulmonary tuberculosis with degenerated thyroids may be almost as pernicious as in dogs deprived of their thyroids?

In the ingenious Eck fistula experiment an anastomosis is made between the portal vein and the vena cava, a ligature being applied to the portal vein close to the liver, thus cutting out the liver from the portal circuit. A dog thus prepared and fed upon meat dies in three days; when fed upon a diet of bread and milk, the animal lives in excellent health for an indefinite length of time. The urotoxic coefficient of such a dog was found to be increased to nearly three times the normal after the tying of the portal vein, from which the conclusion may be drawn that with a high-protein meat diet the poison-destroying work of the liver and of the body is three times as great as on a low-protein or non-flesh dietary.

4. *Disease of the Adrenals.*—Authorities agree in regard to the great frequency with which the adrenals are involved in connection with tuberculous affections of the lungs. The relation of these glands to oxidation, to general vital resistance, and to the toxin-destroying functions of the body gives great significance to this fact. Behring showed that blood serum (sheep's) possessed sterilizing properties far superior to those even of the stronger solutions of carbolic acid and corrosive sublimate, which were formerly employed in surgical operations. This property of the blood being, very probably, largely due to the adrenals, as well as the ability of the blood and tissues to oxidize or destroy toxins, it needs no argument to indicate the importance of promoting intestinal asepsis in all possible ways in pulmonary tuberculosis, and especially by avoiding a dietary which must flood the blood and the tissues with toxic products to an extraordinary degree, thus weakening or destroying its bactericide properties.

5. *Concurrent Disease of the Kidneys.*—Drs. Flick and Walsh state that "nephritis occurs very frequently in tuberculosis." Among the causes they mention the effects of "the toxin excreted through the kidneys from lesions elsewhere." Grancher and Martin produced nephritis in dogs by attempts to establish immunity with increasing doses of tubercle bacilli. "The longer the animal lived and the higher the resistance it attained, the

greater were the chances of nephritis." Drs. Flick and Walsh regard nephritis as "one of the complications in tuberculosis most to be dreaded;" and especially "because it is a complication which comes through the very process which leads to recovery, namely, immunization." These eminent observers assert that "many patients with tuberculosis die by way of nephritis as the real cause of death," and indicate as the symptoms pointing toward nephritis, "a pasty skin, unusual fatigue upon slight exertion, shortness of breath, high specific gravity of urine, hyalin and granular casts, albumin, etc."

The Third Annual Report of the Phipps Institute, 1905, contains an exceedingly interesting report by Joseph Walsh of the autopsy findings, from which it appears that 84 per cent of the cases showed chronic changes in the kidneys. Tuberculosis of the kidneys was observed in 58 per cent, or about two-thirds of the cases in which the kidneys were affected. In the other one-third, the changes were wholly due to the excessive amount of toxins which the kidneys were compelled to eliminate. The fact that the majority of patients in whom diseases of the kidneys occur are not subjects of tuberculosis affords sufficient evidence that other toxins besides those produced by the tubercle bacillus may be important factors in the production of this condition. That renal disease, both acute and chronic, may result from the absorption of toxins originating from putrefaction in the alimentary canal is no longer doubted. The renal lesions present in various intestinal infections are sufficient evidence of this.

In the face of such facts it would seem to be quite unnecessary to urge the necessity of exercising every possible care to avoid excessively taxing the kidneys, not only by suppressing irritating condiments, the importance of which is recognized, but by avoiding any unnecessary increase of the nitrogenous wastes of which the kidney is the chief outlet.

It seems proper then to raise the question whether the feeding of large quantities of protein in tuberculosis may not aggravate one of the most grave and incurable of the lesions incident to this malady. Indeed, we may even inquire whether a high-protein dietary may not be very largely responsible for the great number of cases of renal disease observed as a complication of pulmonary tuberculosis. Certainly it cannot be denied that the kidneys must be considered when arranging the bill of fare of the patient suffering from phthisis pulmonalis.

Every modern author on the dietetic treatment of renal disease insists that the amount of work required of the kidneys must be diminished as much as possible, and that hence the proportion of protein should be reduced, that the extractive matters of meats should be especially avoided, and even that the amount of sodium chlorid should be reduced to the minimum. Hutchison urges that flesh foods should be allowed only in very small quantity in renal disease, and advises that the proteins should be "derived largely from vegetable sources." Freidenwald and Ruhrah entirely prohibit strong meat broths and beef teas, and reduce the protein to 30 or 40 grams. They also limit the chlorid of sodium and state that "meat should be used cautiously."

Hirschfeld emphasized the inability of the diseased kidney to eliminate nitrogen. The diseased kidney is like an obstructed filter. With a diet of 70 grams of albumin a healthy kidney eliminates 10.1 grams of nitrogen, the diseased kidney 9.3 grams. When the albumin ration is increased to 130 grams, the healthy kidney eliminates 14.5 grams, and the diseased kidney only 11.7 grams. When the ration of 130 grams is continued for a few days, the disproportion increases, the diseased kidney eliminating only 12.7 grams, while the healthy kidney eliminates 18.6 grams. Thus the diseased kidney under a ration furnishing 533 calories of protein—considerably less than the amount often given consumptives—is able to eliminate only two-thirds of the nitrogen intake.

It is evident, then, that the consumptive patient who is fed on a high-protein diet is thereby not only rendered more liable to fatal hepatic and renal complications, but through the accumulation of the retained products of protein metabolism, all his functions are hindered, and all his tissues are exposed to a damaging influence.

Gautier emphasizes the necessity of reducing, in renal disease, "the toxins and other offensive products to the minimum by diminishing the consumption of the food principle from which they originate (protein)." He permits meat in small quantities, 20 grams of protein, but recommends especially bread and cereals, cereal soups, purées of vegetables, potatoes, rice, and all fruits, giving as the reason that "these foods do not produce, or only in very small quantity, urinary toxins." W. Gilman Thompson says, "Whatever views may be entertained in regard to the causation of albuminuria, it is agreed by all that cooked meats, eggs, and highly seasoned foods in general are injurious in all cases.'' Senator, of Berlin, in cases of serious renal disease, prefers to prescribe only vegetables, salads, fruits, or an exclusive milk diet of two liters per diem. It seems a just conclusion from the facts presented that the recommendations made in relation to diet in renal diseases are equally applicable to cases of pulmonary tuberculosis.

If a high-protein ration in general is open to suspicion in tuberculosis, a flesh diet is particularly questionable for several reasons:

1. Flesh proteins more readily undergo putrefactive decomposition than do vegetable proteins.

2. Flesh foods as eaten always contain, ready formed, a considerable amount of toxins which have resulted from putrefactive processes which take place in the flesh after killing, while being "ripened'' in preparation for the market.

3. Flesh foods always contain multitudes of putrefactive bacteria in active growth, and hence introduce into the intestine an agent in the highest degree calculated to encourage intestinal autointoxication and to aggravate some of the gravest features of the disease.

4. Lusk, Rubner and various other physiologists have shown that protein causes a waste of energy by overstimulation of cell activity. With a high protein ration the body cells are so overstimulated that they expend more energy than the protein supplies. In a tuberculous patient the cells are already suffering from overstimulation due to toxins produced by the tubercle germ. This is the cause of the fever, weakness, emaciation, and wasting of the tuberculous patient. It is evident that a diet which increases this destructive tendency cannot be otherwise than harmful, and that a diet rich in flesh proteins produces this effect cannot be questioned in the light of modern physiologic research.

While the writer is not a specialist in the treatment of pulmonary tuberculosis, he has during more than forty years had constantly cases of this sort under his care, and has had considerable opportunity to observe the effects of both a low-protein and a high-protein dietary. A very considerable number of patients have been seen to make good recoveries from well pronounced tuberculous disease of the lungs on a dietary which furnished not more than 200 calories of protein in the form of eggs, milk, and vegetable protein, and often less. On the other hand, there has frequently been a rise of temperature and an aggravation of other symptoms when a digression was made to a diet of flesh foods such as beefsteak, etc. Several times patients have come under our care who had been subjected to forced feeding with disastrous results. The enthusiastic advocacy of forced feeding by Débove, Broca, and Dujardin-Beaumetz, and the slavish way in which for a time the example of these clinicians was followed, has led in not a few instances to most untoward results. The chief evils of these large dietaries doubtless result from the excess of protein and fats.

Bardswell and Chapman found that "patients make much less satisfactory progress on the very large diets than on diets of considerably smaller nutritive value." The same investigators observed that "any considerable increase in the protein of the diet produced a disproportionate excretion of nitrogen, an increase in the amount of imperfectly oxidized proteins in the urine, a decrease in the percentage of nitrogen absorbed, and an increase in the amount of aromatic sulphates excreted, indicating increased intestinal putrefaction." These authors conclude that the most satisfactory diet for the consumptive "*is one which represents only a moderate increase of a diet suitable for him in ordinary health.*"

Dr. Lawrason Brown notes that the method of forced alimentation rarely yields permanent success, and also warns against the use of foods which are likely "to give rise to toxic action of the liver and kidneys."

Of all foodstuffs flesh meats are the ones which "encourage toxic action of the liver and kidneys," or rather toxic effects due to excessive demands upon the liver and kidneys for the destruction and elimination of poisons. If used too freely, eggs may give rise to similar symptoms, particularly the whites of eggs and especially when eaten raw as in the form of egg-nog, as elsewhere pointed out. Milk proteins, and particularly milk in the form of acidophilus buttermilk, present this necessary element in a form in which it is in the highest degree digestible and assimilable. And it should be remembered that Sherman has shown that the addition of a few ounces of milk to a diet otherwise affording only ordinary cereal proteins, affords a supply of complete proteins sufficient to wholly meet the needs of the body (p. 132).

The facts relating to the feeding of tuberculous cases may be summarized as follows:

1. A low-protein dietary, .80 to 1.00 gram of albumin per kilogram of body weight per diem, is entirely consistent with health, vigor, and a high degree of efficiency and endurance in health (one calory per pound of body weight).

2. While a patient suffering from pulmonary tuberculosis doubtless requires a small increase in the intake of nitrogen, an excessive increase involves grave dangers to the patient, both (*a*) by decreasing his general vital resistance, and (*b*) by imposing unnecessary and dangerous burdens upon the liver, kidneys, thyroid, and other organs which are already overburdened and often seriously crippled in this disease.

3. There is no evidence that a larger proportion of consumptives recover under a high-protein diet than under a protein ration sufficiently above the Chittenden standard to replace the nitrogen loss due to febrile conditions in certain states of the disease.

4. In consumption the organism is required to deal with various highly virulent poisons which overstimulate and ultimately cripple or destroy the thyroid, adrenals, liver, and other antitoxic organs. A high-protein diet produces similar effects in healthy animals and persons, and destroys life in animals whose poison-destroying functions are seriously impaired.

5. A high-protein diet is recognized as an important factor in the causation of renal disease and is universally condemned in grave affections of the liver and kidneys. Vegetable proteins are much less objectionable than flesh proteins for the reason that they are entirely free from toxins and very much less readily undergo putrefactive changes in the intestine.

A copy of the paper above quoted was sent to a number of physicians specializing in the treatment of pulmonary tuberculosis, including superintendents of tuberculosis sanitariums. In the considerable number of letters received there was a general concensus of opinion against the overfeeding of tuberculous patients, then and still in great vogue, and especially against the very high protein diet. The late Dr. Sternberg, who after retiring from service as Surgeon General of the United States Army, for some years conducted a sanitorium for tuberculous patients, in a letter to the writer endorsed most heartily the views above expressed and stated that he had demonstrated to

his entire satisfaction by his own experienc
patients are injured by a free use of meat.

Since the publication of the paper above
ous other papers have appeared in the me
attention to the dangers of a high protein d
Dr. F. J. Walter, in the Journal of the *Amer*
ciation, 1919, calls attention to the danger o
genous diet in this disease showing that a pa
may become the subject of albuminuria and r
culosis of the kidney, which may hasten the di
mination.

The report of observations made by Mc
the Russell Sage Foundation at Bellevue Med
York City, on the metabolism of consumpti
question of the amount of the food intake i
sound scientific basis. According to these
amount of food taken by the tuberculous p
more than 20 or 25 per cent greater than tha
tient at rest, or 500 calories more than req
metabolism of the individual; and the amour
more than half that required by the old sta
only two-thirds of that demanded by the sta
In a dietary balanced on this basis there is
for steaks, chops and similar meats, for in a
moderate amount of milk, eggs, cereals and
ordinarily compose a lacto-vegetarian dietary,
of meats, there will be as much protein as the
of and more than this must be clearly recogni
Malt sugar contains more iron than the sam
steak and much more than cow's milk. Chan
flora is of the greatest importance in all cases
ease. Patients always give a history of chron
The intestinal autointoxication resulting fro
evitably lowers vital resistance and prepares t
velopment of tubercular disease. By the use
B. Acidophilus culture, or Acidophilus-Lac
change may be readily made within a few day
peated whenever the stools become foul smelli
will of course at once restore the putrefactive
reason for its disuse. An antitoxic and r
should be faithfully adhered to (pages 568, 58

regimen is needed when the patient is under weight (p. 583). Special care should be taken to secure a large intake of food lime at least double the normal requirement or 200 per cent. (See pages 179, 182). Milk, greens, cottage cheese, legumes, certain nuts (almonds, filberts), bran, oatmeal, and malt sugar are the best sources of lime (Table XIV, p. 182). Meats of all sorts are highly deficient in lime. Protose, gluten bread (40%), and gluten biscuit are rich in lime, iron and protein and on this account most valuable foods for a consumptive. Yeast extract (Savita, Marmite) should be used daily to insure a full supply of vitamins.

THE DIET IN INTESTINAL TUBERCULOSIS

In general, the diet should be the same as in pulmonary tuberculosis. Carbohydrates (starchy foods and malt sugar) are especially needed to combat emaciation. The intestinal flora must be changed and kept non-putrefactive.

When the patient suffers from diarrhea, milk, milk porridge, rice, milk toast, purées of potato, greens and sweet fruits should constitute the dietary. Wheat flakes, granola and milk sugar may be added, with acidophilus buttermilk.

THE DIET IN SYPHILIS

In syphilis the liver and kidneys suffer because of the toxins with which they have to deal, even when they may not be the seat of specific lesions. It is important to note that huge doses of drugs which are necessary to destroy the parasite of syphilis are by no means without deleterious effect upon the liver and kidneys. It is, in fact, simply a question of the choice of evils. The powerful arsenical preparations used to destroy the syphilitic parasite inevitably injure the liver and kidneys, not merely temporarily but doubtless more or less permanently just as does a severe attack of typhoid fever, small-pox or any other grave infectious malady. For example, it has been shown by life insurance statisticians that an attack of typhoid fever diminishes life expectancy 50 per cent. Certainly a person who has had syphilitic infection cannot expect to become a centenarian even though he may have undergone most thorough antisyphilitic treatment, since the treatment itself involves no small amount of damage to vital organs, although far less than would have been produced by the syphilitic parasite and the poisons produced by it if the treatment had not been applied.

Bailey and Mackay have called attention to the toxic changes which frequently occur in patients under antisyphilitic treatment, causing among other tissue damage, changes resembling those of yellow atrophy of the liver, while Davis and Whipple have shown the importance of reducing protein and fats to a minimum in cases in which the liver has been damaged by chloroform given for anesthesia or by other drugs. The increase of urea and cholesterol in the blood following the use of salvarsan, point to injury to the kidney as well as the liver. The observations made by these investigators, together with facts long known concerning the function of the liver in defending the body against metallic and organic poisons, show clearly the importance of lessening the work of this vital organ by reducing the protein and fat of the diet to a minimum while supplying it with the necessary glycogen by means of a diet rich in carbohydrates to assist it in its work of destroying and detoxicating not only the syphilitic poisons but the toxic substances used to destroy the parasite. An eminent authority, writing upon this subject, remarks, "a diet of cooked skeletal muscle is not favorable for rapid liver repair." "Cooked skeletal muscle" is a fine scientific euphemism for beefsteak, roast beef, mutton chops, and other forms of meat, all of which are unfriendly to the liver and kidneys.

It has long been known to those familiar with the advantages of a non-flesh dietary that the disuse of flesh foods of all sorts is of very great importance in the treatment of syphilitic patients.

The diet in syphilis should be a combination of the antitoxic, laxative and reconstructive dietaries, (pages 568, 580, 588). It is important to reduce the alimentary toxins to the lowest point possible and by all means available to raise the patient's vital resistance and recuperative powers.

In cases of syphilitic stomatitis, rice gruel, with the addition of a little butter or cream should be the almost exclusive diet for a few days on account of the bland character of this preparation.

In syphilitic cirrhosis the diet should be followed which has been recommended for ordinary hepatic cirrhosis (p. 676).

Patients preparing to undergo treatment with salvarsan should first have a change of flora (p. 552), and then faithfully follow the antitoxic diet. Numerous observers have noted that the inconveniences and dangers of the treatment may be avoided by the disuse of meats of all sorts. In the treatment of a very large number of cases in which this regimen has been employed at the Battle Creek Sanitarium, most strikingly favorable results have been obtained. Says Dr. W. F. Martin, specialist of the Battle Creek Sanitarium staff, "I consider a low protein antitoxic dietary of essential importance in the treatment of cases of syphilitic disease."

CHRONIC PARASITIC INFECTIONS

Actinomycosis. In this disease the indication is for an antitoxic and reconstructive diet. On account of the restricted activities of the patient special care should be taken to keep the bowels active by the free use of bran or agar and paraffin oil.

Trichinosis. In this disease, which is due to the invading of the body by trichinæ, the pork parasite, the fever diet is indicated during the acute febrile period. If the patient should have the good fortune to recover, he should forever after abjure pork in every form, the ordinary source from which this dreadful infection is derived. Many persons give a history indicating repeated infections by the parasite. Unfortunately this disease is incurable. There is no known method for destroying the parasite after it has entered the tissues. The permanently crippled organism requires scrupulous adherence to an antitoxic dietary.

DIET IN DISEASES OF THE SKIN

During more than forty years the writer and his colleagues have successfully treated various forms of skin disease, chiefly by regulation of the diet. Nearly forty-five years ago the writer had under his care a prominent educator, a professor in a State College, who suffered from eczema of such a severe type that his entire body was covered. With a strict non-flesh dietary and without other applications to the skin than simple warm baths and soda lotions, he was soon wholly free from the disease. Hundreds of similar cases might be cited.

More than twenty years ago Dr. L. D. Bulkley of New York began the advocacy of a rice diet in psoriasis and eczema. At first he only required his patients to avoid beef and mutton. Of late years he has made the diet more strict, excluding entirely all flesh foods, even meat soups, poultry, eggs, and fish. He has had a number of patients for years on an absolutely vegetarian diet, allowing only butter, and restricting the use of milk.

Bulkley thus describes the result of this dietary: "The effect of this cutting off of the supply of animal nitrogenous food has been very remarkable and striking in many instances (a considerable amount of nitrogen is still supplied by certain vegetables, as the legumes and oatmeal). Patients continually notice the change in the color and character of the eruption, it paling and becoming less scaly, and even entirely disappearing in some weeks, with absolutely no local treatment.

"Note has been made repeatedly that when there has been a neglect of the dietary element there has been a recurrence of the eruption, which again yielded rapidly when stringent measures were enforced.

"On the other hand, there has been a number of patients who have faithfully pursued this plan of treatment, in whom a long-existing psoriasis has remained absent, and who, having become accustomed to the diet, say that they have lost the desire for flesh food and will not touch it again.

"Little need be said in regard to the general subject of a vegetarian diet, for abundant experience has shown its value under many conditions of health and disease. The opinion is, I believe, gaining ground both among the medical profession and the laity that far too much meat is eaten by those who can get it. . . . In my experience patients have felt remarkably well when this was rightly directed and carried out, and in numerous instances I have found distinct and steady gain in weight in the spare, and loss of weight in the obese, when tested repeatedly on the same scales."

The results of Dr. Bulkley's tests were so successful that he called upon the writer for a dietitian trained in the School of Home Economics of the Battle Creek Sanitarium and established the meatless regimen in the "Skin and Cancer Hospital" of New York City, where it has been employed now for many years and in the successful treatment of thousands of cases.

Eczema. Eczema and most other forms of skin diseases are greatly influenced by diet. Various skin maladies are commonly associated with chronic intestinal toxemia and are apparently due to the lowered vital resistance resulting from the absorption into the blood of large quantities of putrefaction products developed in the intestine. In some cases the skin eruption may be due to anaphylaxis. These eruptions may occur in persons who are sensitized to some particular foodstuff. The food substances most often incriminated are oysters or other shellfish, pork, mutton, veal, strawberries, buckwheat, eggs, sometimes milk, and even tomatoes. In all cases of eczema and other forms of skin eruption a strict antitoxic diet should be adopted. Meats of all sorts should be eliminated and a search should be made for the particular substances to which the body may be sensitized by means of tests with the various allergens which are now prepared for this purpose. These tests must be conducted by a physician who is acquainted with this line of research.

In beginning a course of treatment, the intestinal flora must be changed (p. 552); any existing colitis must be cured by diet and treatment of the colon and the antitoxic dietary must be faithfully followed.

The dietetic treatment of acne, and other chronic skin disorders is essentially the same as that required for eczema. Acne often requires a very considerable restriction of the use of animal fats, and special attention must be given to the colon.

Eczema in Infants. M. Langstein (*La Semaine Medicale,* September, 1908), confirms the observations of M. Finkelstein in relation to the beneficial results obtained by withdrawing chlorid of sodium from the food in eczema of infants. In four children suffering from eczema, the disease disappeared entirely in four weeks on a diet from which four-fifths of the amount of salt ordinarily present had been withdrawn.

Gershun (*Vratch*) calls attention to the fact that skin diseases in infants are frequently due to poisons in the mother's food. Psoriasis and eczema have been shown to be due to this cause, the disease disappearing when the mother discards meats.

Special attention should be given to the bowels, which should be made to move three times daily by the use of bran, paraffin oil and spinach. The flora should be changed by use of *B. acidophilus* and milk sugar (p. 562).

Certain infants are sensitized to cow's milk. In such cases, Malted Nuts or almond milk may be substituted for milk. Butter should be given in potato soup, and a soup of malted barley may be advantageously used. The cure will be facilitated by the use of Lanolin Cream, of which the following is the formula: Lanolin, 2 drams; boroglyceride, 1 dram; cold cream made with white vaselin, 6 drams. Apply freely several times a day.

DIET IN CANCER

Dr. William Mayo has for some years maintained that the eating of hot food is the cause of the great frequency of cancer of the stomach. It is known that burns give rise to cancer. For example, cancer of the skin of the abdomen is common among the natives of Kashmir, as the result of burns due to the kangri, a basket of coals which these mountaineers carry under their clothing as a sort of "warming pan." Cancer in this region is almost unknown among other people.

Cancer of the gullet is rather frequently observed among the men in China, but is rarely met among the women. The men in China eat their rice very hot, while the women eat it cold, at the second table.

Dr. Mayo finds a similar explanation of the greater frequency of cancer of the stomach in men in the fact that the wives pour the coffee and serve their husbands first and themselves last, and hence take their coffee at a lower temperature.

Bulkley, of New York, has for many years maintained that the use of meat and tea and coffee is to be regarded as a leading cause of cancer. In the leading skin and cancer hospital of New York City, a strict vegetarian diet has been adopted in the treatment of cancer, and with a high degree of success in slowing the progress of the disease, although a cure is not to be expected in a disease which destroys the lives of ninety per cent of all who become affected by it, in spite of all that surgery and other means of cure have thus far been able to accomplish.

Dr. Carl Petersen, the eminent statistician, in a recent article confirms the observation of Professor Maynard that there is a close relation between diabetes and cancer, the coefficient of correlation being according to Petersen, seventy-one per cent.

Careful study of the statistics of these two diseases shows that whenever there is an increase in the mortality from cancer there is a like increase in the number of deaths from diabetes, and the reverse. Williams has shown that the mortality from cancer increases in proportion to the amount of meat eaten. He has accumulated an enormous mass of evidence which seems to demonstrate the close relation between flesh-eating and cancer.

Guelpa and Case have shown that intestinal stasis and resulting autointoxication is very frequently associated with diabetes, from which the inference may be made that diabetes is also associated with flesh-eating. Indeed, there are not lacking authorities who recognize in high protein feeding a potent cause for the great increase in diabetes observed in recent times.

Gastric Cancer. A bland reconstructive diet is indicated. Rice is in many cases more acceptable than any other food. Sugar water, prepared by the addition of two ounces of malt sugar or milk sugar to a pint of water, may be used to advantage when more solid food is rejected. The introduction of sugar water by enema is also of great service in sustaining the patient's energies and especially in preparing him for a radical operation when this is deemed advisable.

Sugar feeding not only supplies the patient with the sort of nourishment he most needs, but at the same time serves as a biologic disinfectant and antiseptic for the stomach, presenting the growth of the putrefactive organisms which swarm in the cancerous stomach in these cases, because of the absence of hydrochloric acid.

An antitoxic diet, that is, a diet which discourages the development of putrefactive poisons in the intestine, is specially to be commended as a means of combating cancer. Such a dietary should be adopted by all persons suffering from cancer, and also by those who are so unfortunate as to have a cancer heredity. During the last forty-five years the writer has had unusual opportunities for observation in relation to the influence of a non-flesh dietary upon the occurrence of cancer. Of many thousands of flesh-abstainers with whom he has been acquainted, he has known during this period of only four cases of cancer in persons who had been for a long time flesh abstainers, and in one case recovery occurred without removal of the cancerous growth. There can be no doubt that among the thousands of persons under observation who escaped the disease, as the writer believes through flesh abstaining, there must have been a considerable number who were especially susceptible to cancer through heredity and who were able to overcome this special susceptibility by a non-flesh dietary. This conclusion seems unescapable when it is remembered that ten to fifteen per thousand of all persons past middle age die of cancer.

An antitoxic dietary excludes not only flesh foods but tea, coffee, alcohol, tobacco, vinegar, mustard, pepper, peppersauce and other condiments, as well as all other toxic substances.

A liberal use should be made of fresh fruits and vegetables because of the large amount of potash which they contain. Potatoes, carrots, raw cabbage, lettuce and cucumbers are especially to be commended.

In connection with an antitoxic diet it is also necessary that special care should be taken to secure normal activity of the intestines. The bowels should be emptied at least twice a day, and three or four movements will be much better. Normally, the bowels should move after each meal. This degree of intestinal activity greatly promotes purity of the blood by hastening undigested food remnants through the alimentary canal so rapidly that there is little opportunity given for putrefaction.

The use of such antitoxic foods as buttermilk, sour milk, yogurt buttermilk, and such special ferments as *B. acidophilus* is also an important and efficient means of combating intestinal autointoxication by restoring and maintaining the normal intestinal flora, that is, the friendly bacteria which promote the formation of lactic acid in the intestines and thus prevent the growth of putrefactive germs.

DIET IN SURGICAL CASES

The ordinary hospital dietaries are open to severe criticism, especially in the light of modern discoveries in human nutrition. There is almost a total lack of lime, iron or vitamins in the regular hospital "light diet", and the various gruels and other liquid preparations are well calculated to encourage constipation and intestinal toxemia. Milk contains lime, but is lacking in iron. Bouillon and broth are the chief stock in trade of the hospital cook. These time-honored preparations fill such a large place in the current hospital bill of fare that it may seem almost equal to sacrilege to denounce them; but, in the light of modern knowledge, they must go. They are too pernicious to be allowed a place in a bill of fare from which everything toxic or germ-breeding should be excluded. For more than forty years the writer has conducted a surgical service through which many hundreds of cases have passed every year and from which all meats and meat broths and bouillons have been excluded. The advantages of this regimen was early demonstrated. More than twenty-five years ago I reported several series of abdominal operations in which unusually good results had been obtained, which I attributed to the special system of feeding employed.

In a series of 395 abdominal sections within six years (1889-1895) the mortality was 2.3 per cent. The above figures include a series of 233 cases of non-septic ovarian cysts with one death, and 165 successive cases of ovarian tumors or diseased appendages with no deaths. The significance of these figures will be appreciated when it is remembered that at the period named our modern surgical technic had not yet been developed. Rubber gloves were not worn, and the usual mortality rate in abdominal cases was 15 to 20 per cent or more.

The usual hospital regimen greatly needs reformation. The bill of fare should be enlarged by the addition of many foods rich in vitamins, lime, and especially iron. Bran is needed for roughage, with agar and other forms of cellulose. Bran is also a good source of food lime and iron. Vegetable broths, rich in vitamins and salts, should take the place of the animal extracts and bouillons, which are nothing less than solutions of uric acid and other poisons as pointed out long ago by the elder Flint and eminent French physicians. Meats of all sorts may well be dismissed from the hospital larder. All, without exception, are septic, putrescent, swarming with the terrible bacillus of gas gangrene, *B. Welchii,* and other highly virulent mischief makers. Put into the intestine of a feeble patient who has barely survived a grave operation, nothing could be devised in the shape of food more likely to become a cause of disaster.

Lucas-Championnière of Paris, Surgeon-General of the French Army, observed that a high proportion of urea in the urine, a necessary result of meat eating, was unfavorable to recovery after an important operation or injury.

Diet before Operation. After the flora has been changed by a few days of fruit regimen, a non-toxic dietary should be adopted before the operation, as well as after the operation, and until convalescence is fully established. This requires a reduction of the protein to as low a level as safety will permit, certainly not exceeding 10 per cent of the total calory value of the ration.

Bouillon and meat extracts of all sorts must be discarded. Said Sapelier, the eminent French surgeon, "Bouillon is a veritable solution of ptomaines." Meats must necessarily be discarded because of the readiness with which the undigested residues undergo putrefaction in the colon, besides introducing myriads of putrefactive bacteria which are always present in fresh, salted and smoked meats of all kinds.

The famous surgeon, Paget, in his lessons on surgery, many years ago, asserted that "The high death rate from operations in cities, as compared with rural districts, is due to the fact that city dwellers eat large quantities of meat, while country dwellers in Europe taste meat only on occasions."

More than a dozen years ago Tissier called attention to the fact that vegetable proteins are only about "half as prone to putrefy as animal proteins," and Torrey has recently demonstrated the same fact. Neither bouillon nor meat broths are ever served to my surgical patients. Tea and coffee as well as wines are also scrupulously excluded from the bill of fare.

Storing up Glycogen. It is most desirable that that wonderful poison-destroying organ, the liver, and the poison-eliminating kidneys should be gotten into as efficient a condition as possible before the operation, so as to be prepared to deal with the anesthetic, itself an active poison, as well as the great influx of poisons naturally following the operation. For accomplishing this, it is especially important that the patient's diet should be rich in carbohydrates so that the patient's liver, muscles and body cells may be well stocked with glycogen.

It is current practice in abdominal cases to give the patient no food on the day of the operation. This plan has the disadvantage that it brings the patient to the operating table fasting and necessarily with his store of precious glycogen greatly reduced. Glycogen is necessary not only to support the heart in its activity, but to aid the liver in dealing with the great flood of toxins thrown into the blood by the anesthetic and the traumatism of the operation and which are the principal cause of shock, as shown by Cannon. An abundant store of glycogen in the liver and the body cells is the best possible means of protection against shock. In order to enrich the patient's store of glycogen, I have for years adopted the practice of giving the patient eight or ten ounces of malt sugar between the last meal the night before the operation and the hour of the operation. Four to six ounces of malt sugar dissolved in water may be given in divided doses the morning of the day of the operation.

The value of this ready-to-use nutriment is very great, not only as a means of replenishing the liver's store of glycogen, but to sustain the heart, which consumes a fraction of a calory of sugar at every beat, and especially to combat the acidosis invariably produced by the anesthetic.

Renal Efficiency. If a high non-protein nitrogen content is shown by the blood test, or the urinary test ration shows renal inefficiency, the operative hazard may be enormously lessened by a few weeks' careful treatment with an atoxic diet, changing the intestinal flora (p. 552), and improving elimination.

Prophylaxis against Acidosis. If the carbon dioxide tension is found to be less than 34, which is not infrequently the case in meat eaters and in persons whose nutrition has been seriously interfered with by fever, low diet or other cause, the body's store of glycogen must be replenished and the carbon dioxide tension raised to normal by carbohydrate feeding, particularly by the use of malt sugar and milk sugar, of which a half ounce may be given in a glass of water every hour, for a day or two before the operation, or even every half hour if the patient is able to absorb so much fluid. If necessary, retaining enemas of malt or milk sugar, two ounces to the pint, are given.

Post-Operative Feeding.

The post-operative feeding of surgical cases is a matter which has received far less attention than its importance demands. In many cases, the patient's nutrition has been seriously interfered with for some time before the operation by the conditions which make the operation necessary. In my opinion, the starvation of patients, either before or after operation, is not only unnecessary but is highly prejudicial to the patient's interests, lessening the chance of recovery and increasing the danger of serious complications. Food is a most important regulator of metabolism. Assimilated food furnishes the material upon which the cell works, both in the performance of its functions and in the repair of its structure. If material is not supplied in the form of food, the body must draw upon its own tissues.

Food, likewise, is the only source of energy for the body. The heart alone consumes approximately two ounces of sugar every twenty-four hours.

Furthermore, food furnishes a physiological stimulus to the living cells. The rapid loss of strength and endurance as the result of fasting, and the marvelously rapid restoration of energy by appropriate nourishment, afford ample evidence of the helpful stimulus which may be secured through proper feeding. This stimulation is doubless due in large measure to the presence of vitamins which abound in certain foods and in which vegetable broths are rich. These vegetable broths differ from bouillon and animal broths in the fact that, while rich in vitamins, they contain no urea and other waste matters of which animal broths are largely made up while lacking vitamins almost altogether. Yeast extracts (Savita, Marmite) are especially valuable.

The eating habits of most patients lead to an accumulation of protein wastes in the tissues. Since all excess of protein must be eliminated as urea and other nitrogenous wastes, both the liver and kidneys are overtaxed by this excessive protein metabolism causing a predisposition to acidosis and uremia. In addition to these waste products from excessive protein metabolism, the blood and other body fluids are likely to be saturated with toxins of bacterial origin originating from the putrefactive changes in food residues in the colon. On this account it is most unwise to feed a prospective surgical patient meats of various sorts as a means of preparing him for the operation, or to advise such a diet for promoting convalescence after operation. On the other hand, a low protein diet for a few days before the operation and immediately following the operation, is most advantageous. The blood may be more rapidly built up by a lacto-cereal diet, with the addition of liberal quantities of greens than by heavy meat feeding.

There is usually a sufficient amount of fats stored up in the tissues to supply the needs of the body for a few days, and the fat intake in post-operative cases may be advantageously diminished because of the inhibitory effect of the operation upon the secretion of gastric juice. Gastric juice is important in stomach cases to prevent the putrefaction of stagnant gastric fluids and so maintain a condition favorable to healing. It is well to remember, also, that the body is able to manufacture fat from carbohydrates and that starch and sugar are, under normal conditions, the chief sources of body fat.

Abundant carbohydrate feeding is hence of great interest in relation to surgical cases. Farinaceous foods of all sorts, fruit juices and malt or milk sugar are the most appropriate materials for feeding a patient on the days before operation and two to five days succeeding.

Feeding After Gastro-Enterostomy, Pylorectomy and the Polya Operations.

The feeding should begin early—as soon as vomiting is controlled, for several reasons: The sooner feeding can be begun, the less will be the danger of exhaustion, since the food supply, rather than the tissues of the patient, will thus be the source of energy.

Another benefit to be derived from early feeding, which is especially noticeable in operations upon the stomach and gall bladder, is the suppression of "hunger pains" which Carlson has shown to be due to violent contractions of the stomach. Bland food introduced into the stomach is often more effective than morphia or any other anodyne in controlling the pain following operations on the gall bladder or the stomach.

It is well to remember, also, that food is a natural laxative. Taking food into the stomach sets up peristaltic waves which travel over the entire intestinal tract, thus encouraging evacuation and the elimination of waste matters from the colon. This early peristalsis has the effect to straighten out kinks in the intestine and to break up newly-formed adhesions which have not yet become organized. It is even advantageous in many cases to make use of moderate quantities of agar-agar or gruels containing bran. By supplying these colon stimulants, the early restoration of normal bowel action may be greatly encouraged.

I find careful early feeding is especially advantageous in cases of gastric surgery, even in gastrojejunostomy, pylorectomy and the Polya operations, as well as in other cases.

The objection that foods may be irritating does not hold good for the reason that bland foods of the sort mentioned are by far less irritating than the acrid matters invariably present. Such foods certainly will be as well tolerated by the stomach as the stagnant, germ-infected, often foul-smelling and irritating material usually found in the stomach after operations on this organ. The effect of taking food in such cases is to dilute or wash away the stagnant fluids resulting from oozing, involuntary swallowing of the saliva, etc. Displacing the putrefying gastric contents by a small quantity of bland and sterile rice gruel, often produces a most favorable effect, relieving nausea, hunger pains and other distressing symptoms.

The fact that taking fluid into the stomach may give rise to gastric secretion cannot be regarded as an objection to early feeding for the reason that the gastric juice is the normal disinfectant of the stomach, and its presence will help to suppress putrefactive changes in the gastric fluids, and will hence promote the healing process rather than to prevent it.

When the patient does not vomit, malt sugar water containing two ounces of malt sugar to the pint or fruit juice of some sort containing the same proportion of sugar, is given in spoonful doses hourly, and affords the patient exactly the right kind of nourishment required. Pathogenic organisms do not grow in sugar water, fruit juice or gruel, while they thrive in blood serum, bouillon and broths. Of course, it is important to avoid overfeeding. A half ounce of rice gruel every two hours while the patient is awake, the first day, increased by half an ounce on the second day, causes no disturbance in the average case. After the first few days, spinach purée may be added to promote blood building and thorough evacuation of the colon.

Bouillon, beef juice, broths and similar preparations are carefully avoided, and, in fact, are never admitted to my ward. Vegetable broths, which are quite as appetizing as any of the preparations mentioned and wholly free from unwholesome properties, are freely used. A bouillon prepared from yeast extract (Savita, Marmite) so closely resembles bouillon that it is readily accepted in place of it, and is, in fact, more palatable.

Gruel diet is relied upon only for a very short time, a few days at the most. Simple purées of vegetables and fruits are allowed after the first two or three days, and these are accompanied by agar jellies or special bran preparations to encourage bowel action. Purées of spinach or other greens should appear daily on the menu in some form. These lime and iron containing foods are essential to rapid blood building and tissue repair and help to sustain the heart in its arduous work. Green foods are also rich in the vitamins which are as essential for the rapid repair and rebuilding of the tissues as for the normal growth of young animals.

Every meal should be carefully balanced, not only for proteins, fats and carbohydrates, but for cellulose, food lime and iron and other salts and vitamins.

In cases in which a great portion of the stomach has been removed, great care must be taken in the mastication of the food or else it should be taken in the form of purées. Food must be taken in moderate quantities, and on this account it is necessary in some cases that the time between meals should be shortened, the patient taking four meals a day instead of three. This is especially necessary during the first few weeks following the operation. In several cases in which the writer has found it necessary to remove the stomach, X-ray examinations made by Dr. Case after the operation have shown that Nature has developed a new pylorus which behaves in a remarkably normal manner, holding the food back in the duodenum and the stump of the stomach for three or four hours as in the healthy stomach.

After the Polya operation, intense and constant hunger is often experienced for some months. In such cases frequent small meals may be necessary for comfort when the hunger pain is severe.

Diet in Post-Operative Peritonitis.

In peritonitis the chief indication is to maintain the strength of the patient by such food as will supply energy without encouraging the development of toxins. The patient's liver and kidneys are already overwhelmed with toxins which are being absorbed from the peritoneal cavity, and there is likely to be pronounced intestinal stasis; hence, foods rich in protein should be withheld, also foods rich in fat, which, when present in large amount, tends to increase stasis. Carbohydrates encourage peristalsis, combat acidosis, and at the same time supply the body with the most readily available source of energy. Malt sugar is exceedingly valuable for use in this class of cases, a fact which seems to have been largely overlooked by writers on dietetics. The writer has made use of this valuable nutrient in the feeding of many thousands of surgical cases within the last 25 years and has found increasing reason for confidence in its value. Sugar water may be used by enema and also by mouth. When vomiting is persistent, a Rehfuss tube should be introduced into the stomach or duodenum and through this the accumulating fluids may be pumped out and sugar water introduced in their place, and with great benefit to the patient. By this plan the amount of toxins absorbed into the blood may be greatly reduced and at the same time much needed nutriment may be introduced.

Jejunal Feeding. When an intestinal fistula is established for the relief of obstruction, sugar water, preferably milk sugar

or malt sugar, two ounces to the pint, shou
stead of plain water. Three or four quart
in fractional doses in 24 hours. By this
energy is sustained and acidosis is prevente

Diet After Operation on the Gall Bladder.

In cases of gall bladder operation, ver
of the diet is essential to insure the results
tion. During the first four or five days th
same as after operations on the stomach. La
or antitoxic diet should be closely adhered
Meats of all kinds must be carefully discarde
never be eaten. Meats and raw eggs greatl
nal putrefactions and continually reinoculat
the very bacteria which has made necessary t

The diet should be very "loosening," a
clude a liberal quantity of wheat bran. A
three times a day is generally none too muc
quantity of agar, with an abundance of fru
greens, and other laxative foods, not as frequ
of fare, but as a part of every meal. The re
oil is needed in most cases for the purpose of
secure three full evacuations daily.

Especial care must be taken to masti
oughly. Prolonged mastication prevents t
of the food and hence too rapid discharge of
ach into the duodenum, which is important w
has been removed, because of the loss of t
for bile.

Diet in Accidents and Emergency Cases.

When the accident or emergency is of s
the patient must be confined to bed, especial
etary is of great importance. First of all, th
be diminished in quantity. The food require
cumbent in bed is not more than half or tw
same person engaged in ordinary activities.
requires while he is resting in bed less than
food usually eaten by a man engaged in ha
sive intake of food under such conditions is
the evils which are naturally the result of i

who has been accustomed to an active life. Indigestion, so-called "biliousness," and other inconveniences, in many cases very quickly make their appearance. Inactivity produces a tendency to constipation, which will be increased by the lessened volume of food unless care is taken to avoid this by increasing the amount of roughage. On this account, bran should be used in liberal quantities,—three or four heaping dessertspoonfuls at each meal, or half as much agar.

Greens should be largely used also. In cases in which there has been a considerable loss of blood, the importance of the use of greens is especially great because of the richness of this class of foodstuffs in iron. Lentils and other foods rich in lime and iron (See Table XV. p. 183) are also indicated.

Dates, figs, raisins or malt sugar should take the place of cane sugar and other sweets. Fruits should be very freely used, especially acid fruits and tomatoes, and such coarse vegetables as cabbage, cauliflower, turnips, lettuce and celery.

In cases of bone injury, care should be taken to make the dietary rich in lime. It should be remembered that the cereals are poor in lime, also potatoes and most vegetables. Légumes provide lime in abundance. An ounce of peas, beans or lentils contain several times as much as an ounce of beefsteak. Buttermilk and skimmed milk are also good sources of lime as are gluten preparations, almonds and hazelnuts.

Gluten preparations such as bread made from 40% gluten flour or gluten biscuit, should be more freely used by surgical patients. 40% gluten biscuit supply six times as much food iron as does ordinary beefsteak.

DIET IN DISEASES OF THE EAR, NOSE AND THROAT

Dr. J. A. Stuckey, of Lexington, Kentucky, (*Medical Review of Reviews*, July, 1909), holds that diseases of the ear, nose, and throat are generally the result of intestinal autointoxication. In several hundred cases of disease of the nose and accessory sinuses, and diseases of the middle and internal ear, the Doctor has found in all marked evidences of intestinal autointoxication. Examination of the urine has shown quantities of indican and other poisons formed in the intestine in nearly every case. It was also found that by treating the patient with the proper measures to combat intestinal autointoxication, great relief was obtained from the ear, nose, and throat disorders. The effect of various drugs such as quinine, for example, upon the ear evident that poisons generated within the irritate the nerves and other tissues of the as shown in asthmatic attacks, rheumatic pai ful affections of the eye, ear, nose, and th flora (p. 552), and adherence to a stric (p. 568), are essential for the most suc affections of the nose, ear, and throat. It is to secure efficient bowel movements three This may be accomplished by the method (p. 632).

DIET IN DISEASES OF TH

The supreme importance of diet in the forms of eye disease has not been apprec cent years. Dr. Ernest Clarke, an eminent us that the eye registers in a very delicat of intestinal toxemia. The mode of regis plains:

"In quite early youth the crystalline small bag of semi-fluid jelly, and accommod its being squeezed by the action of the cil a manner that its anteroposterior diamet great is the squeezability (if I may use the the very young, that an accommodation often be recorded. As age advances, a h sclerosis, goes on in the lens as in all the othe and so its elasticity becomes less and less, un when the near point of accommodation, w fullest accommodative power, has so far rece eye requires assistance in the shape of a c to see near objects distinctly. This harden be delayed by the absence of, and accelerate certain poisons in the system, and intesti very high place in the list.

"One individual has only an accommoda while another has 8.5 D. What is the diffe two individuals? In the one aged forty wi dative power the lens has hardened prem equal to the lens of a man aged fifty-five.

ing from premature senility, and in the great majority of cases, in physical appearance, habits and powers, he is aged fifty-five. There are many causes which help towards this premature senility, but the factor common to a very large majority of them is intestinal stasis. On the other hand, those whose accommodative power is higher than normal look much younger than their years, and are in every way younger, and on going into their history it will be found invariably that they have taken the greatest care to avoid the least suspicion of intestinal stasis.

"These facts, in connection with the premature senility of the lens, are another proof of the correctness of the old saying that 'a man is as old as his arteries'; the premature sclerosing of the vessels often taking place at the same time as the process in the lens.

"I think I have said enough to prove that premature hardening of the lens is a very constant sequela of intestinal stasis, and this is a very useful and easily ascertained index."

Here are three cases which have come under the writer's observation and which fully confirm the observations by Prof. Clarke:

A young woman of eighteen years found her sight failing. Examination by an eye specialist showed that the young woman's eye accommodation was so much impaired that she needed glasses such as are usually worn by a person of fifty years. By a change of regimen and improvement of bowel action as recommended in this work, the abnormality in a few weeks disappeared and her eyes were young again.

A college professor of fifty years, wearing glasses adapted to a presbyopic person of his age, after following for a few months the regimen recommended in these pages found his eyes improved to such a degree that he had the same range of accommodation as a normal person of thirty-five years.

A physician sixty years of age, who had for some time adopted a highly laxative, antitoxic regimen and who had taken care to change his flora, found his glasses uncomfortable, and on examination by an oculist discovered that his glasses which had been very carefully fitted some years before, were more than ten years too old for him. A change was made to "younger" glasses, and he is still wearing them at the age of seventy, with entire comfort, although they are adapted to a person of forty-seven years.

In the above cases the rejuvenation of the eyes was accompanied by the disappearance of numerous symptoms of senility, and a great increase in physical and mental vigor and endurance.

Dr. Hugh Blake Williams of Chicago, Professor of Ophthalmology in the Illinois Medical School, reports a case of interstitial keratitis which proved to be caused by intestinal autointoxication. The patient had been suffering with attacks of vomiting and diarrhea alternating with constipation prior to the appearance of eye symptoms. Local applications of atropine and dionin gave only temporary relief, but after the patient had been put upon a non-flesh dietary the corneal opacity cleared thoroughly and the ocular inflammation completely subsided.

A number of cases of neuroretinitis have been reported which were evidently associated with intestinal toxemia, the patients showing large quantities of indican in the urine. Pains in the eye as well as in other parts of the body attributed to neuritis, rheumatism and gout, are without doubt in many cases due to toxins of intestinal origin.

In view of the above facts, it is evident that the eye is very sensitive to conditions which may result from errors in diet, particularly intestinal toxemia. In both acute and chronic eye affections, thorough attention should be given to elimination of food residues by the aid of a laxative diet (p. 580), and the diet should be strictly antitoxic (p. 568). The intestinal flora should be changed by an efficient application of the fruit regimen with lactose or lacto-dextrine, and this should be from time to time repeated whenever the stools show any trace of putridity.

INFANT FEEDING

The very best possible food for a very young infant is its own mother's milk, unless the mother is ill. The mortality of bottle-fed infants is several times that of those who are breast fed. Mothers' milk differs from cow's milk. The milk of animals differs as does their blood. Mother's milk contains subtle elements which are not found in cow's milk and is richer in the things a human infant needs than is cow's milk. Mother's milk is so important that a very little, even so little as a spoonful or two daily is of great value to a bottle-fed infant as a supplement to its artificial diet.

The mother should never forget that her own milk, even if deficient in quality and quantity, is better than any kind of artificial food. Only under the pressure of urgent necessity and positive orders of a competent physician should she give up nursing her baby.

If the child does not thrive on its mother's milk the physician should be consulted and the mother's diet should be carefully regulated.

If the mother eats carelessly for a single day or even a single meal, the milk may be affected and the child may suffer.

After the mother leaves her bed there frequently follows a period of depression, due to her physical weakness, and she is likely to feel discouraged, and want to give up nursing. She fears that she is not going to be strong enough to furnish the necessary food and to stand the drain upon her own strength. She should, however, not allow herself to yield to this fear. If necessary, artificial feeding may be used to supplement the mother's milk for a short time, if the supply is deficient. In such a case, the directions given elsewhere for milk modification should be carefully followed (See p. 810).

The quantity of milk furnished by nursing mothers differs greatly. The amount may be only sufficient to supply the infant with a few ounces two or three times a day, making supplementary feeding necessary, or there may be much more than any child can take.

Certain foods increase the flow of milk. This is especially true of nuts. "Malted Nuts," a preparation consisting of nuts and malt sugar, has a well deserved reputation for greatly increasing the flow of milk and improving its quality (Hoobler). It is extensively used for this purpose in lying-in hospitals.

The nursing mother should take daily not less than three pints of water in addition to the water taken at meals and in food.

The bowels must be kept well open, that is, moving three times a day by the use of bran and paraffin. Greens and fresh vegetables should be used daily and freely and fruits should be made a part of every meal.

Mother's milk is clean, whereas cow's milk is always more or less contaminated with stable filth. The danger is only partly obviated by pasteurizing, for while the process of pasteurization destroys the germs of tuberculosis, typhoid fever, scarlet fever, diphtheria and septic sore throat, infectious diseases which are likely to be borne by milk, the putrefaction germs derived from the cow's colon which are produced from spores are not destroyed. It is for this reason that sterilized milk undergoes putrefaction, while raw milk sours. This is especially true in the intestine of the child, since the sugar of milk which tends to prevent putrefaction is absorbed in the small intestine of the child, leaving undigested curds to undergo putrefactive changes in the colon.

The stools of a child fed on pasteurized, or sterilized milk, usually become dark colored and putrid, with a very offensive odor, while those of a breast-fed child remain yellowish in color, and slightly acid in odor, because of the presence of acid fermentation instead of putrefaction, one of the remarkable means adopted by Nature for the protection of the child against autointoxication. Intestinal toxemia in a child is a much more serious matter than in an adult, for the reason that an adult has acquired a certain resistance to the action of intestinal toxins.

Chapin has called attention to the fact that the character of the food of a young infant has much to do with the development of its alimentary canal. He points out that the hard, tough curds formed by cow's milk are adapted to a digestive apparatus in which a large part of the work of digestion is done in the stomach. In the case of the cow, goat and sheep, the stomach constitutes more than half of the digestive tract. In animals like the horse and donkey, which do not ruminate, the stomach forms only 10 per cent of the digestive tract, nearly all the work of digestion being done in the small intestine.

The digestive apparatus in man is much like that of the horse, the stomach forming about 20 per cent of the whole digestive tract. The milk of the mare and the ass, like human milk, differs from that of ruminating animals in the fact that it does not form large tough curds destined to be retained in the stomach for a long time, but small flocculent masses which pass quickly into the intestine, where the principal work of digestion is done.

It is a great advantage to an infant to have the benefit of breast-feeding for the first few weeks of its life, even though artificial feeding must be adopted later, not only for the reason that the character of its food has a remarkable influence in the development of its digestive apparatus, as shown by Chapin, but because of a fact pointed out by Langer, who discovered that so long as the child is breast-fed, the colon bacilli develop slowly in the colon, and apparently do little or no harm; whereas, later, when cow's milk is fed, the colon bacilli develop rapidly and acquire a high degree of virulence, which shows itself in indigestion, arrested growth and in various other ways. Langer does not assign any reason for the interesting fact which he records, but the writer would suggest that a sufficient reason may be found in the fact that breast milk contains fifty per cent more lactose than does cow's milk. It is well known that lactose discourages the growth of the colon bacillus and encourages the development of *B. acidophilus* and other beneficent acid-forming organisms. It is also to be noted that in the presence of lactose the colon germs cease to develop toxins, thus losing their power for mischief.

Feeding Schedule. The number of feedings daily and the quantity for different ages is shown in the following table:

FEEDING SCHEDULE

3rd day to 3rd month	3rd month to 8th month	8th month to 12th month
6 A. M.	6 A. M.	6 A. M.
9 A. M.	9:30 A. M.	10 A. M.
12 noon	1 P. M.	2 P. M.
3 P. M.	4:30 P. M.	
6 P. M.	8 P. M.	6 P. M.
9 P. M.		
12 midnight	12 midnight	10 P. M.

During the day the infant may be awakened from sleep to nurse. The habit of regularity is quickly established. It is not necessary to disturb the child at night, provided he is healthy and seems to be thriving. In fact, when he is normal and growing, it will be better for the infant and for the mother to miss the midnight feeding. If in the interval he is restless, give a half feeding of warm boiled water from a bottle. This can be done without thoroughly awakening the baby.

Perfect regularity in nursing is especially to be emphasized. The child should be fed at exactly the same hours each day. This is quite as important in breast-feeding as in bottle feeding.

The child must not be kept at the br
twenty minutes. Over-feeding is more likel
der-feeding. Sometimes the mother's milk
baby must not be allowed to nurse so long.
be then given to supply the amount of fluid

A Simple Plan for Artificial Feeding of Inf

The amount of food required by a child
and size. Children require much more
to their size than do adults. For example,
may require one-sixth as much food as an ad
times as much; while a child one year old m
as much food as an adult weighing seven ti

Many complicated methods and formu
fant feeding have been proposed and recon
authorities. Numberless special foods have
offered for sale at high prices. But exte
conclusively demonstrated that complex and
of food preparation and expensive foods po
tages; the best results may be attained by v
pensive means.

Milk Mixtures. Pure cow's milk is too
a food for an infant which has been breast f
the child must be gradually accustomed to
at first milk mixtures to which considera
added. As the child grows older, less water
necessary to add malt sugar or milk suga
contains much more sugar than does cow's m

The complicated formulas which have
recent times have no advantage over the f
mulas which have been well tested in the f
of babies, and which may be easily prepared
intelligent mother:

First month, one-third milk, two-thir
ounces malt sugar to the quart. One o
calories.

Second to sixth months, half water, h
ounces of malt sugar to the quart. One ou
calories.

Seventh to ninth months, use two-thir

water, two ounces of malt sugar to the quart. One ounce gives twenty-one calories.

Tenth to twelfth months, use full milk, adding two ounces of malt sugar to the quart. One ounce gives twenty-eight calories.

Infant Feeding Program.

Age	Weight	Quantity in 24 Hrs. Feeding	No. of Feedings	Amt. of Feedings	Calories Daily
Birth	7 lbs.	20 oz.	8	2½ oz.	350
1 mo.	9 lbs.	24 oz.	6	4 oz.	400
2 mo.	10½ lbs.	28 oz.	5	5½ oz.	475
3 mo.	12 lbs.	30 oz.	5	6 oz.	510
4 mo.	13 lbs.	32 oz.	5	6½ oz.	545
5 mo.	14 lbs.	34 oz.	5	7 oz.	575
6 mo.	15 lbs.	36 oz.	5	7¼ oz.	612
7 mo.	16 lbs.	32 oz.	5	6½ oz.	640
8 mo.	17 lbs.	33 oz.	5	7½ oz.	660
9 mo.	18 lbs.	34 oz.	5	8 oz.	680
10 mo.	19 lbs.	28 oz.	5	5⅔ oz.	700
11 mo.	20 lbs.	29 oz.	5	5¾ oz.	725
12 mo.	21 lbs.	30 oz.	5	6 oz.	750

Infants under one year should not take more than thirty-two to thirty-six ounces of food daily. In changing to a stronger diet, that is, from half milk to two-thirds milk, or two-thirds milk to full milk, the quantity should be reduced at first. After the child weighs eight pounds, the amount may be increased one ounce of the milk mixture for every six ounces that it gains in weight.

The Infant Ration. A simple method of determining the number of calories a child should eat has been proposed by Lassablière. It is this: Multiply the height measure in inches by 35, or multiply the chest measure by 58, or, multiply the sum of the height and the chest measure by 22½.

Supplementary Feeding. One of the most important of all foodstuffs which may be usefully added to milk, in infant feeding, is malt sugar.

It is the only sugar which is native to the body, as it is produced in the body by the digestion of starch.

The free use of lactose sometimes produces digestive disorders, and an infant will assimilate more maltose. But lactose is often useful to change the infant's intestinal flora.

Cane sugar is irritating to the stomach and should never be used in infant feeding. Candy should never be given to infants or young children. The use of this unwholesome sugar is the cause of much disease and suffering in both children and adults.

Orange Juice. The juice of sweet oranges is a most important, almost essential, aid in the artificial feeding of infants. Orange juice is rich in vitamins. When sterilized milk is used, orange juice is necessary to supply the vitamins which boiling destroys in the milk and which are absolutely essential for the healthy development of the infant. The observations of Holt and others show that every bottle-fed child requires daily at least one ounce of orange juice when cow's milk is used. The orange juice should be given in doses of two or three teaspoonfuls at intervals during the day. When malt sugar and cereals are used, the amount of orange juice must be increased in proportion to the amount of sugar or cereals added to the milk. The more sugar or starch, the more orange juice is needed. In children who show evidences of scurvy, four or five ounces of orange juice must be given daily to supply the needed vitamins. It is now known that in cases in which it was formerly supposed that infants were suffering from an excess of cereals in the food, the real fault was the absence of vitamins in the carbohydrate given. Fine wheat flour and prepared infant foods are lacking in vitamins. This discovery has already been the means of saving thousands of infant lives. Every mother should know that orange juice or tomato juice is indispensable in the artificial feeding of infants of all ages. These highly valuable juices should be used in all cases of artificial feeding. All "baby foods" are deficient in vitamins. The same is true of all cereal preparations, and even certified milk is often rather deficient in these essential food principles. It is now known that tomato juice, either fresh or canned, is fully equal to orange juice.

Purées. Purées of ripe fruit such as sweet apples, pears, and bananas, prepared by pressing the fresh pulp through a fine collander, are exceedingly wholesome and useful additions to the dietary of the bottle-fed infant. Modern physiological experiments have shown the necessity for variety in foodstuffs, especially to insure a full supply of all the different vitamins, salts, and other elements.

Recent studies of infant nutrition have shown that one of the reasons for the poor nutrition of very young bottle-fed children, as shown by failure to grow at the proper rate, is the lack of the growth-promoting vitamin which is found in abundance in mother's milk and in full cow's milk, but is necessarily diminished in proportion when water is added to cow's milk in diluting it. The dilution is necessary, but should be compensated by the addition of the essential vitamin. This may be obtained by adding thin potato soup to the diluted milk or by the use of orange or tomato juice. Yeast extract (Savita, Marmite) is highly useful as a source of vitamins.

Advantages of Malt Sugar.

Another important point is the use of malt sugar in place of cane sugar. Cane sugar is a pure carbohydrate product. It contains nothing but sugar and is intensely sweet. Malt sugar is less sweet—an advantage, because in this respect it more nearly resembles lactose, the natural sugar of milk.

Malt sugar has the great advantage of containing water-soluble B. vitamin in considerable amount, as well as iron, lime and other things essential to nutrition. Malt sugar, in other words, is something more than sugar. Purées of dates, prunes and raisins may also be given to infants with great benefit in many cases because of the richness of these fruits in lime and iron.

Malt sugar has also another important advantage which has only recently come to be appreciated; namely, the considerable amount of dextrin which it contains. Pavlov showed the great value of dextrin as a peptogen, that is, a substance which actively promotes the digestive processes. This makes malt sugar of great importance as an aid to the feeble digestive powers of the average infant.

Torrey, Rettger and others have recently shown dextrin to be one of the best of all substances for promoting the growth of the protective germs.

Certain acid-forming germs make their appearance in the colon of the breast-fed infant within a few hours after birth, the *B. bifidus* and *B. acidophilus.*

When cow's milk is fed, these essential protective germs tend to disappear, their place being taken by putrefactive germs which produce poisons causing dark, foul-smelling stools, fretfulness, restless sleep, lack of appetite, delayed growth, and other symptoms of the chronic poisoning induced by dangerous germs which, unfortunately, are always found in great numbers in commercial cow's milk.

Torrey, experimenting with white rats, found that by feeding dextrin the protective germs could be restored within three or four days, the putrefactive and colon germs disappearing almost wholly. This is a discovery of very great importance and helps to explain the benefits derived from the feeding of barley gruel, malt soup, potato soup, and other preparations containing more or less dextrin. In malt sugar, dextrin is found in greater abundance than in any other food suitable for young children, a fact which in part doubtless explains the great benefits following the substitution of malt sugar for cane sugar in the diet of bottle-fed infants, an observation which has led modern specialists in the care of children to recommend malt sugar as greatly superior to either cane sugar or milk sugar in infant feeding.

The malt sugar should be added to the milk or milk and water mixture in the proportion of one ounce to the pint. Malt sugar is now obtainable at most drug stores.

Gruels prepared from wheat germs are very rich in vitamins and are advantageously used in supplementing the dietaries of artificially fed children.

Recent observations show that mother's milk as well as cow's milk is often deficient in vitamins because the food of the mother or of the cow is lacking in these food accessories. The food of cows in winter, when they eat much dry feed, is certain to be deficient in growth stimulating elements. The winter food of mothers is likely to be deficient for a similar reason, unless pains are taken to supplement the usual dietary with liberal quantities of greens, fresh vegetables, tomatoes, and fresh fruits.

The fat of cow's milk is one of the most serious causes of trouble in the artificial feeding of infants. Many infants are able to digest fats only in small amounts and when the food contains an excess, the undigested portion undergoes decomposition in the intestines, forming irritating and poisonous substances. An excess of fat is one of the most common causes of indigestion and bowel troubles. This difficulty is overcome by diluting the milk with skimmed milk or with water, or by removing a part of the cream.

The fat of cow's milk consists of globules much larger than those of human milk which is one of the reasons given for the inferior digestibility of cow's milk. The milk-fat of Holstein and Guernsey cattle occurs in smaller globules than that of other breeds of dairy animals.

Beef tea, meat juice, and meat broths are in the highest degree unwholesome for infants. These preparations have practically no food value. They represent the excretory products in the meat and encourage putrefaction in the intestines.

Eggs are also a dangerous food for young infants. Many infants are "sensitized" to eggs so that a single feeding may produce highly poisonous, even fatal, effects.

The common practice of taking the baby to the table and permitting him to "nibble" all sorts of foods is most pernicious. The infant's stomach is exceedingly delicate and is able to digest only the most simple foods.

Normal growth is impossible in the face of mal-assimilation from any cause. In artificial feeding, it is sometimes necessary to try several different formulas before the right one is found. There are no absolutely fixed rules.

Many infants become anemic soon after the sixth month because of the small amount of iron in cow's milk. This may even occur in the case of breast-fed infants, for mother's milk contains little iron. The liver of the child born at full term contains iron enough to last it for eight or nine months, but it is reasonable to suppose that a premature infant born from three to eight weeks before full term must be launched into the world with a deficient store of iron in its liver. Such infants will need a supplementary supply of food iron earlier. Test the blood of the infant for hemoglobin whenever there is any ground for suspicion that its supply of iron may be insufficient. Malted Nuts may be used in alternate feedings with much advantage.

One teaspoonful of purée of steamed spinach, or steamed carrots may be given daily after the sixth month. Four ounces of malt sugar daily will insure the infant an adequate supply of food iron. Cane sugar and milk sugar supply no food iron.

Oatmeal is a specially wholesome food for all young children who have attained the age of six months, and may often be used earlier with advantage. According to Chalmers Watson, oatmeal and milk constitute a better food than bread and milk because of the stimulating action of oatmeal on the thyroid gland which tends to accelerate growth.

It is better that the oatmeal should not
Just sufficient boiling to render it liquid en
veniently is quite sufficient. Long boiling im
vitamins. An eminent specialist in the di
records that he found bottle-fed babies did
sisting of milk with the addition of fifty gr
starch, which ignorant mothers had administ
ing to follow directions. All the cereal starch
small amounts in the raw state and aid bowel
intestinal toxemia.

Buttermilk for Infants. Marfan, an em
diseases of children, gives the following direct
ration of buttermilk for infants suffering fro
ing it to be an almost infallible remedy:

A little sour milk is added to the milk to
is set aside for 24 hours and allowed to sour.
time it is skimmed, then churned for 40 m
through a fine sieve. An ounce of malt sugar
of rice gruel are then added with a little
is very slowly heated to boiling while const
cream whip. This preparation should be ma
the child until the diarrhea disappears. Bu
with *B. acidophilus* is doubtless the best of all
reason that the *B. acidophilus* is the normal
of the intestine. Acidophilus buttermilk shoul
cooking, as heat will quickly destroy the bacilli
to plant in the colon.

Water for Infants. Infants often suffer
The crying of young children is often due to
hunger. A child under one year of age shou
pound of body weight two ounces of liquid,
of water or liquid food. Children over a ye
less than one quart of water daily.

Lime Water. The extensive use of lim
gredient of modified milk used for bottle-fe
important a brief reference to this widely use
Lime water differs little from hard water exce
it contains more lime. Tibbles says that the
is disputable. Bungé declares that inorganic
lated. As a matter of fact. the amount of
is less than that found in cow's milk. A

contains 26 grains of lime (CaO), while a pint of lime water contains only 20 grains or less than four-fifths as much. In milk and other foodstuffs the lime is in organic combination with the casein and so is prepared to be utilized by the body, whereas in lime water it is in its native mineral form and needs to be acted upon by the cells of the living plant before it is suitable for human food. It is believed by Tibbles and Bungé that to insure utilization lime "must be organically united to the proteins of the food."

The addition of lime water or soda to milk is an objectionable practice for the reason that these alkalies injure, and may even destroy, the vitamins upon which the development, health and even the life of the infant depend.

Cane Sugar Poisoning. According to Fischl, cane sugar, in excess, may in young infants give rise to fever, with rapid breathing, stupor, tendency to collapse, and the occurrence of sugar in the urine. This is especially likely to occur from the use of milk preparations containing much sugar, such as the Swiss condensed milk and similar preparations.

Cane sugar should be excluded from the diet of infants.

Malt Soup and Scurvy. Experience has shown that malt soup or malt soup extract, when fed to young children, is likely to lead to the development of scurvy. When malt soup or any other artificial food is used in infant feeding, orange juice or tomato juice should be added in proper quantity.

The Deleterious Effects of Meat Diet for Children. Professor Sherman of Columbia University, an able physiologist, several years ago called the attention of the profession to the fact that meat is lacking in lime salts. This fact alone renders it an unsuitable food for children.

Dr. Winters maintains that one of the many evil consequences of the early use of meat by children "is the loss of relish it creates for the physiological foods of children—milk, cereals and vegetables." Says Dr. Winters, "A child that is allowed a generous meat diet is certain to refuse cereals and vegetables. Meat, by its stimulating effect, produces a habit as surely as does alcohol, tea, or coffee, and a distaste for less satisfying foods. The foods which the meat-eating child dislikes contain in large proportions certain mineral constituents which are essential to bodily nutrition and health, and without which the processes of growth and development are stunted."

Dr. Winters attributes to the use of me
orders to which children are subject, partic
of urine, rheumatism, chorea, rheumatic i
tonsils and torticollis, night terrors, urtic
edema, anemia, convulsions, and *petit mal.*

According to this author, "there is mo
ness, anemia, rheumatism, valvular disease
chorea at the present time in children fron
and its preparations in the diet than from a
bined." No doubt these observations are we
diet is as unnatural for a young infant as fo

The Infant's Stools. In the feeding of
careful observation of the character of the fl
importance. This may be done in a crude b
simple examination of the stools. If the sto
and of putrid ammoniacal odor, putrefactive
be known to be dominant. The flora need
regulation of the diet in a manner elsewhe
this purpose(p. 552). Porter, Morris and
Dis. of Chil., 1919), who have made a spec
testinal bacteria in children, tell us that:

"In children who suffer from certain
intoxication with malnutrition, the intestina
uniform manner from the normal, and this
characterized by the establishment of bact
nantly putrefactive. The return of these
health is coincident with a regression of th
ward predominantly fermentative types an
balance between the two types. Such chan
flora can be brought about in the intestine c
by withdrawing of animal protein and persis
amounts of lactose (from 2 to 4 oz. daily),
drates (the period which may be necessary t
tion being from 10 to 40 days). . . The
of the symptoms of intoxication and a return
to nutritional health coincides with the rec
of a fermentative flora (*B. acidophilus*). I
are the carbohydrates most effective in enc
establishment of a fermentative flora in the
and children." (*Exper. Sta. Record,* Feb.,

Nursing. Observation of the habits of primitive people and lower animals indicates that the nursing period naturally continues until some time after the eruption of the first teeth is complete. Garner noted that apes, our nearest kin in the animal world, nurse their infants from five to seven months. Their first teeth are complete by the third month. Young camels nurse for a year although they begin to eat with their mothers a few weeks after they are born.

Among primitive people nursing continues until the first teeth are complete, or for three years, although considerable other food is eaten. Pictures of young children standing at the breast of savage mothers are common. Referring to this fact, Dr. Vander Bogert well says, "But we must remember that these are primitive people in their natural state and that because of natural conditions they are able to produce a better milk supply and for a longer time." This simple statement contains much food for thought. In how many other ways is the tame or civilized human being inferior to his wild or savage brothers and sisters because of unnatural conditions of life!

It is a matter of general observation that the modern civilized woman is unable to produce a good quality of milk for a longer time than one year. Babies that are breast-fed for a longer time do not develop well and in later life develop physical defects and digestive disorders which are attributed to too long breast-feeding.

The proper rule seems to be to begin feeding wholesome, simple food in small quantities as soon as the first teeth appear, especially purées of greens and of fresh vegetables, fruit juices and gruels. From week to week the quantity and the variety of foods may be increased. Orange juice and tomato juice may be given almost from the outset, and encourage growth, appetite and bowel action.

Children should be taught from a very early age to make use of sweet fruits instead of cane sugar. Dates, figs and raisins. first in the form of purées, then in their natural state, should be made a regular part of the child's bill of fare.

Vomiting of Infants. Vomiting in bottle-fed infants may be due to swallowing air while feeding. To prevent, hold the bottle so as to keep the neck wholly filled with milk.

If large curds are present, the milk mixture is probably too strong. More water should be added.

If the vomit has a rancid odor, the stoma out. Less fat should be given and more malt

If vomiting is very persistent, there may the pylorus requiring operation. In such case not be delayed. An X-ray examination shoul

Simple regurgitation of the food after presence of tough curds, has no significance child may have eaten a little too much.

Hot applications over the stomach before will often control troublesome vomiting.

Diarrhea in Infants and Cholera Infantum.

In cases of intestinal irritation with diar fantum, the child should be fed on a thin gruel until the bowel looseness is checked, a should employed (See also p. 678).

HYPERSENSITIVENESS OF INFANTS FOODSTUFFS—ANAPHYLA

For many years it has been known tha as adults, may be made very ill by small and other substances which are ordinarily har as 1831 Elliotson noted the connection bet plants and hay fever. Hutchinson, in 1884, vation that certain patients suffered from na abdominal pain after eating eggs. Within r number of similar cases have been reported, that both children and adults are frequently milk, shellfish, meat, and other substances. reported by Dr. Blackfan, of Baltimore, will ing as examples of the effects of various fo sensitized persons:

Case 1.—An infant, that had been ex was given, when six weeks old, a small amo This was immediately vomited. One month spoonful of milk caused a severe general r vomited and had diarrhea. He became cya trated that the physician considered him dan prepared with cow's milk brought on a simil the administration of three drops of a 1 in densed milk. Cow's milk in any form an amounts always caused vomiting, loose stools, cyanosis, irregular respirations and prostration. He was able to take goat's milk without any symptoms. In order to determine that the symptoms are due to cow's milk the protein of cow's milk was applied to the skin. This was followed by an area of edema and erythema after four hours. When introduced in this manner cow's milk caused the same general symptoms as when taken by mouth. Protein from beef, egg, horse serum, barley, human milk and goat's milk caused no reaction when applied to the skin. The baby was nursed at the breast and given supplemental feedings of goat's milk until ten months old, after which minute amounts of cow's milk were given by mouth. Gradually the amount was increased until the hypersensitiveness to cow's milk was overcome. The paternal aunt had an idiosyncrasy to shellfish and the paternal grandfather and great-grandfather had asthma.

Case II.—An infant aged two years, was breast-fed for two months, after which he was given a formula of cow's milk. Cereals, broths and vegetables were added subsequently. Eczema appeared when he was given a soft-boiled egg. This was immediately vomited and he was sick for several hours. Six months later egg was given and he again vomited. The protein of egg, cow's milk, barley, horse serum and beef gave a marked reaction when applied to the skin. By omitting eggs, meats and milk from the diet the eczema improved, and by giving them in small amounts and gradually increasing them he was finally able to take these foods without a return of the eczema. The mother had eczema when she was an infant.

A girl of ten suffered from fever, vomiting, diarrhea, great prostration, edema and intense general itching whenever she ate meat. This child showed no intolerance for milk.

Methods now exist by which a person may be tested for hypersensitiveness by simple means which may be employed by any physician familiar with the technic. No child should be given cow's milk without first being tested for hypersensitiveness; in other words, in changing from breast milk to cow's milk, the cow's milk should be given first in very small quantities. The amount at first should be not more than a teaspoonful and should be well diluted with water, and after it is given, several hours should elapse before another dose is administered, to give opportunity for the development of any possible unfavorable reaction.

By means of "allergens," prepared fro sensitivity tests may be made for more tha articles which have been incriminated c anaphylaxis. The test is usually made aft cination. A slight abrasion of the skin i stance to be tested is rubbed upon it. macula within a few minutes shows sensiti

Hypersensitiveness may be inherited. every member of a family of children are to the same foodstuff. Sensitivity may a infants or develop a few months later. Ve may disappear in a manner wholly unaccou

The foods to which infants and you often sensitized are cow's milk, oatmeal, po juice, chicken, fish and strawberries.

THE RICE REGIM

Rice is a most valuable food remedy i there is marked irritation of the buccal or branes.

A study of the composition of ordinar it to be chiefly composed of carbohydrate, very small granules which are easily broke are very readily digested.

The protein content of rice is small, on the protein is of unusual value, much sup other cereals.

The proportion of fat in rice is very sm of the raw material, and less than one-thir cooked rice.

Rice also differs from other cereals in t of mineral salts which it contains. It contai iron, and an extraordinarily small amount o with other cereals and most other vegetable

When cooked in such a way as to bre grains, rice forms a very smooth, emolient is so bland and unirritating it produces no pleasant sensation when brought in contac as do almost all other vegetable foodstu potash salts or other irritating substances p

For rice feeding, very little salt should ing and no other seasoning. The rice may be served simply boiled or steamed, or in the form of a purée or gruel, or as dry toasted flakes.

When used as a purée, care should be taken to cook it very thoroughly, an hour at least, and in general the cooking grain should be well stirred so as to reduce it to a smooth, pasty consistency.

The energy value of an ounce of dry, uncooked rice is 100 calories. Boiled rice is two-thirds water. The food value per ounce of gruels, purées, and other preparations may be easily calculated by noting the weight of the raw rice and the cooked product, multiplying the former by 100, then dividing by the latter. Suppose the raw material weighs two ounces and the purée made from it, ten ounces; we have $2 \times 100 \div 10 = 20$. That is, each ounce of the purée represents 20 calories. It will be easily seen that the nutritive value of such a preparation is small, a little less than that of milk, and so several quarts are required to furnish a full day's ration even for a bedfast patient. One pint would supply 320 calories, and for 1600 calories, five pints would be required. Such a ration should be taken in four or five meals to avoid overloading the stomach.

In general, it is admissible to add a little cream or sweet sterilized butter to the rice to increase its palatability; but in cases of extreme irritability, only a little salt should be added for seasoning; too much salt should be avoided.

In long-continued feeding, special care must be taken to encourage bowel action. If this is neglected, great injury may be done. The rice is so completely digested and absorbed, practically no residue is left and the result is stasis in the colon and an accumulation of bile, mucus and other intestinal secretions, which undergo putrefaction. This is shown by the appearance of indican in the urine, and headache and other unpleasant effects are likely to appear.

If the bowels are kept active, moving three times a day, putrefaction will not occur, and indican will not appear in the urine. This may be accomplished by the free use of agar or bran and paraffin oil. The best results are obtained with heavy preparations of paraffin which melt at the temperature of the body and with mixtures of bran and agar. When great irritation is present, agar is sometimes preferable to bran, although bran is ordinarily not irritating, as is commonly supposed. Wet bran is like wet paper, and is no more irritating to the stomach and bowels than to the mouth.

It must be remembered that both bulk and lubrication are needed to secure efficient bowel movement. That is, both oil and bran or agar must be used in sufficient quantity to secure three good bowel movements daily. The usual amounts needed are three to six ounces of oil and one ounce of bran or agar daily. These amounts may be doubled if necessary to secure three daily evacuations.

When with a rice diet the stools are foul smelling in spite of three evacuations daily, the fact is evidence that the movements are insufficient; that is, they do not fully empty the colon. There is probably dilatation of the cecum or adhesion of the cecum or appendix with retention and putrefaction of feces. This condition requires the habitual evacuation of the colon every night by a large warm (102° F.) enema,—three or four pints of warm water,—followed by two pints of water at a temperature of 80°—85° F.

If for any reason it is found necessary to avoid all solid food for a time the bran and agar may be omitted and an enema should be given at least twice a day so as to keep the colon empty Paraffin oil should be used in all cases.

For good results with the rice diet all these directions must followed with scrupulous care.

The Technic of the Rice Regimen.

The day's ration may be taken at three meals or may be divided into a number of small meals taken at intervals of two or three hours, as may be indicated in individual cases.

When the diet is continued for more than a day or two, it is important to make sure that the quantity of food taken is sufficient to sustain the patient. If the patient is in bed, sixteen to eighteen hundred calories will accomplish this. This will require the consumption of five or six pints of purée consisting of one part of rice to five parts of water, twice the quantity of rice gruel, or four pounds of ordinary boiled rice.

In most cases, the caloric value of the feedings may be increased by the addition of perfectly fresh sterilized butter in the proportion of one-half ounce to the pint of gruel or purée. This will give to each pint of purée a value of four hundred and fifty calories which at four feedings of one pint each would furnish a full day's ration.

A nut cream prepared from blanched almonds is also an excellent means of increasing the caloric value of the feedings. In many cases, cream or milk may be added. The average value of the milk is about twenty-one calories to the ounce, or practically the same as rice purée. Ordinary cream has an energy value of fifty calories per ounce.

It must also be remembered that rice is almost wholly lacking in iron and lime. For this reason, it should generally be supplemented with purées of greens in cases in which the rice feeding is long continued. Otherwise, the body will lose lime at the rate of ten grains a day and iron at the rate of one-fourth of a grain daily, at which rate the body would lose in six weeks nearly one-fourth of its entire iron content. Five or six ounces of spinach or three or four ounces of 20% gluten in place of an equal quantity of rice will be sufficient to equalize the diet in both lime and iron. In cases of pronounced irritation, purée of spinach will not always be well tolerated

INDICATIONS FOR RICE REGIMEN

The rice regimen is especially adapted to cases in which a high degree of irritation exists in the mouth, the stomach or the small intestine. Among the conditions in which the writer has found this regimen of signal service are the following:

Injuries and Acute Inflammations of the Mouth.

In cases in which the mucous surfaces of the mouth or throat have been injured by the contact of hot liquids or chemical substances, rice gruel will be found exceedingly useful. This bland food causes no irritation by contact with the sensitive raw surfaces. A gruel tube should be used for feeding, which may be given at intervals of three or four hours or in larger quantities three times a day. After each feeding, the mouth should be rinsed with warm water containing a teaspoonful of salt to the pint.

Rice feeding is very useful in tonsilitis, diphtheria, scarlet fever, after operations on the throat, and in mumps.

Gastritis.

In cases of gastritis, rice gruel may be taken in quantities of four to eight ounces at intervals of three or four hours, and will be well retained when almost any other food will produce nausea and vomiting. In general, rice gruel will be found to agree

very much better than milk in any form, a
of a small amount of yogurt buttermilk, say
ten be found advantageous, and will hast
bating the pathogenic bacteria with whicl
fected. As the stomach becomes less sensiti
gurt buttermilk may be increased from day
stitutes half or two-thirds the bulk of the foo
is very marked irritation, it is sometimes n
feeding with teaspoonful or tablespoonful dc
ings are so small, they must be often repeate

Gastric or Duodenal Ulcer.

In cases of gastric or duodenal ulcer,
ders signal service not only on account of its
also because of the favorable influence of
upon the acid-forming glands of the stom
out by Pavlov of St. Petersburg. The addi
lized butter or olive oil in the proportion of
pint of gruel, has the effect to still further i
of acid and will be found highly beneficial.
gruel should be given in tablespoonful dos
hour or two and should be kept cold by pu
taining it in a larger vessel containing ice.

Gastric Spasm.

Modern physiologic researches in rel
functions have shown that pain in the epi
stomach), when no lesion of the stomach c
means of the X-ray, is generally due to exa
of the stomach with spasm of the pylorus,
gall bladder or some lesion of the intestine
In the writer's experience, pyloric spasm w
of the gall bladder or ulcer of the duode
relieved by the taking of four to eight ounc
pared with a little butter or olive oil and lit

Pyloric spasm and epigastric pain ofte
morning, and for this reason it is well to ad
have ready at hand a quantity of rice gruel
of a thermos bottle.

Post Operative-Feeding in Cases of Gastric Surgery.

In cases of complete or nearly complete pyloric obstruction of long standing, it is often necessary to begin feeding at the earliest possible moment after the operation of gastroenterostomy or the Polya operation on account of the extreme weakness of the patient. The contact of rice gruel with the raw surfaces in the stomach produces no irritation. The gastric glands are very little stimulated by the bland liquid in contact with them and so no excess of gastric juice is formed. For these reasons rice feeding is very useful in these cases.

It is true that in most cases of gastric surgery no serious injury results to the patient by a fast of three or four days, as required by most surgeons, but in the writer's experience, fasting is not necessary provided no food but rice gruel or some equally bland liquid is given. The gruel, being sterile and bland, serves as an emollient for the raw surfaces in the stomach and the small amount of gastric juice developed acts as an antiseptic, preventing putrefaction in the stomach and hindering the growth of pus-forming organisms. The feeding also has the effect to cleanse the stomach from the stagnant and putrefactive liquids likely to accumulate there because of the paralyzed condition of the stomach and the oozing of blood and serum from the more or less extensive raw surfaces. Certainly the condition of wound surfaces covered with sterilized rice gruel must be much more favorable for healing than when the surfaces are submerged in the putrefying materials which are almost universally present in the stomach when no food is given for several days after operation. On this account it is the writer's practice to begin feeding the patient small quantities of warm rice gruel within a few hours after the operation in all cases in which nausea and vomiting are not present.

Feeding with rice gruel is also a useful means of relieving the gastric pain which sometimes follows operations upon the gall bladder, probably due to spasm of the pylorus.

Cancer of the Stomach.

In cancer of the stomach, when much gastric irritability is present, as is usually the case in the latter stages of the disease and when obstruction is not complete, rice gruel and rice in other forms usually agrees better with the stomach than any other food, and should be made the staple article of diet, and a mixture

of bland greens, parboiled, so as to remove
may be present, will aid in prolonging the
plying food iron to promote blood formatio
may be employed in many cases of skin dise
days of fruit regimen. In such cases, rice m
ly and in various forms, and should be acc
use of greens, bran, fresh vegetables and
foodstuffs.

A couple of pints of yogurt buttermilk
cases in which sensitivity to milk does not ex
milk does not agree, the yolks of eggs may
milk. Either eggs or milk must be used in
of maintaining a normal supply of complete

The rice regimen may also be used in
milk regimen especially near the end of the
ing and as a means of changing from milk
When used for this purpose, the rice puré
for an equal quantity of milk, or milk may b
quantities to the rice gruel or purée.

Rice combines more readily with milk
any other article of food and may be oc
during a course of milk regimen for a d
patient pleads for a change.

THE WORLD'S FOODS

Edible Foods Growing Wild in the United States. The North American Indians, when this country was discovered by Columbus, were by no means such large consumers of flesh as many have supposed. They subsisted very largely upon the natural products of the earth. In various parts of New England and other localities they had extensive gardens. A British officer, in describing the results of an expedition against the Indians, soon after the arrival of the Pilgrims at Plymouth, announced among other evidences of his sweeping victory that he had destroyed extensive corn fields and several fine orchards which the Indians had planted.

The Indian and other aboriginal Americans gave to the world, as the result of centuries of careful cultivation, several of our most valuable food plants, among which are all the different varieties of Indian corn, including sweet corn and pop corn, 15 varieties of garden beans, the white potato, the sweet potato, watermelons, squashes, pumpkins, tomatoes, the peanut and the Jerusalem artichoke.

Among other plants eaten by the aborigines, and to a considerable extent still in use by various Indian tribes, may be mentioned the roots of the wild parsnip, lily bulbs, camas bulbs, roots of the cat-tail, of fern, several grasses, various water plants, of clover, eel grass, cinquefoil, the kouse root, the arrowhead plant, the carum, bur reed, valerian, balsam root, prairie potato, ground nut, milkweed, Jerusalem artichoke, "man of the earth," brake, tule, wild sago, also wild rice, wild oats, wild wheat, wild rye, tomatoes, peanuts; besides acorns, walnuts, chestnuts, beechnuts, hickories, pecans, and a great variety of other forest products. These foods were not only eaten in their season but were preserved by drying. Fruits were pulped and dried in the sun or in a basket over fire. Roots were stored in the ground.

The Indians understood various methods of cookery, some of which yielded products quite equal to the very latest refinements of the culinary art. Indeed, their method of steaming food for a day and a night by means of heated stones and boiling in water-tight baskets by dropping hot stones into the water, enabled them to produce from the crude products of the forest, dishes capable of tempting the palate of a modern gourmand.

The Indians have known for ages how to produce highly palatable and wholesome vegetable dishes, not a few of which have been adopted by the civilized people who have supplanted them. Hominy, hoecake, and succotash, roasting ears, popcorn, and corn meal mush are examples. They used various sorts of greens and knew how to prepare delicious and nourishing creams and soups from walnuts, hickory nuts, beechnuts, and almost an infinite number of mushes or porridges from pinole, a common name used for a meal prepared by parching and grinding the seeds of the scores of different wild plants with which they were acquainted. Sugar was prepared from the sap of the box elder, the willow and the agave, as well as the maple tree. It was also prepared by boiling chips of the hickory and from watermelons. They also made large use of honey and gathered sweet products from the sugar pine and Douglas fir. In Mexico the fleshy leaves of the agave were roasted and eaten together with the fruit.

Some Indian tribes seem to have appreciated the necessity for an ample supply of food lime, since they carefully saved the bones of fishes and ground them into a fine powder which they added to their food.

The aboriginal Americans were excellent botanists and were thoroughly acquainted with the products of the forest. They readily distinguished between poisonous and non-poisonous plants, and cultivated in their gardens many of the useful food plants which they redeemed from the forest, together with medicinal herbs.

Neither tea and coffee nor any other harmful or intoxicating drink was indulged by the aborigines of this country, although they made many agreeable beverages from the pulp of fruits of various sorts. These primitive people, like the wild animals which shared their forests with them, refrained from drinking at meals, as do all primitive people.

The Eskimos are by no means exclusive meat feeders. They eat all the vegetable foods they can get. Certain tribes gather masu roots for food which they eat either raw or cooked, sometimes fermented. They also make a sort of salad of a species of sorrel mixed with seal oil. The cloudberry, barberry and crowberry are eaten by most Eskimo tribes, together with reindeer moss and other plants found in the stomachs of caribou and other species of reindeer.

The writer is indebted to Dr. Goddard, of the Department of Anthropology of the National Museum of Natural History, for much information concerning the diet of the Western Indians. The California Indians make large use of acorns. They first grind the acorns, then extract the tannin by leaching with warm water. They spread the ground acorns out on a bed of sand which is hollowed out like a shallow bowl. They pour warm water on this and let it leach out. A squaw sits by, weaving and pouring on the warm water occasionally. The process is completed in about half an hour. The water has just the right temperature to dissolve out the tannin quickly but without cooking the meal, which would make it pasty. When the leaching is done, the squaw very carefully removes the acorn pulp, avoiding the sand. The layer next to the sand is removed by pressing the hand upon it. Both sand and acorn pulp adhere to the hand. She dashes a little water gently against the hand, which washes away the sand without washing off the acorn pulp.

The mush made from the acorn is very wholesome and tasty. The Indians thrive on it and prefer it to "white man's food." It constitutes the principal part of the sustenance of some tribes of Indians in northern Mexico. They eat it without salt. They use no salt with their food but occasionally eat small quantities of kelp, a sort of seaweed which they get from the seashore, to which they make occasional visits for the purpose.

The Indians do not relish beef. It was at first difficult to persuade them to eat it.

WILD FOODS

The following foods grow wild in the United States, and have long been used by the Indians and also to some extent by hunters, explorers and early settlers[*]:

Stems or Leaves

- Bisnaga
- Bledo
- Bulrush
- Bracken
- Cabbage Palmetto
- Cactus
- Chicory
- Clover
- Dandelion
- Desert Trumpet
- Dock
- Lambs' Quarters
- Milkweed (sprouts, buds and pods)
- Mescal
- Miner's Lettuce
- Nettle
- Pokeweed
- Purslane
- Red Root
- Red Maids
- Spanish Bayonet
- Scurvy Grass
- Sotol
- Watercress
- Wintercress
- Wild Cabbage

Roots and Tubers

- Arrowhead
- Biscuit-Root
- Bitter-Root
- Camas
- Cat-tail
- Chufa
- Conte
- Coontie
- Florida Arrowhead
- Groundnut
- Harvest Bread-root
- Indian Potatoes
- Jack-in-the-Pulpit
- Jerusalem Artichoke
- Lotus
- Man-of-the-Earth
- Pond-lily
- Salt-bush
- Sand-food
- Sego Lily
- Spring Beauty
- Tipsin
- Tule
- Virginia Tuckaho
- Water Chinquapin
- Wild Anise
- Wild Onion
- Wild Potato
- Yamp

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[*] "Useful Wild Plants of the United States and Canada," by Charles Francis Saunders, Robert M. McBride, New York.

Seeds

Amaranth
Brickeye
Chia
Goosefoot
Indian Millet
Islay
Jojoba
Juniper
Salt-Bush
Songwae
Sunflower
Tarweed
Wild Flax
Wild Oats
Wild Wheat
Wild Sage

Nuts

Acorn
Beechnut
Chestnut
Chinquapin
Groundnut
Hickory
Hog Peanut
Walnut
Piñon

Fruits

Barberry
Blackberry
Black Haw
Buckthorn
Buffaloberry
Cactus
Cranberry
Currant
Elderberry
Fan-palm
Gooseberry
Grape
Ground Cherry
Hawthorn
Huckleberry
Manzanita
May Apple
May-pop
Mesquit
Mulberry
Oregon Grape
Papaw
Persimmon
Pumpkin
Raspberry
Salal
Sahauro
Screw-bean
Serviceberry
Squash
Strawberry
Summer Haw
Teaberry
Tomate del Campo
Tomatillo
Tomato
Tuna
Watermelon
Yucca

Plants Cultivated by the Natives of the New World before 1492.*

Agave
Alligator Pear
Arrowroot
Manioc
Potato
Pumpkin

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* The American Indian, by Wissler.

Bean, kidney
Bean, lima
Cherimoya
Cashew nut
Corn
Guava
Gourd
Jerusalem artichoke
Maize
Prickley pear or Indian fig
Pineapple
Peanut
Papaw
Quinoa
Sweet potato
Star apple
Squash
Tomato

EDIBLE PLANTS

As regards the number of different plants in current use as foods by human beings, information was sought from the office of Dr. David Fairchild, Chief of the Plant Introduction Bureau of the U. S. Department of Agriculture. The request brought in return the following lists of cereals, vegetables, nuts and fruits:

Cereals

All plants yielding farinaceous seeds:

Amaranthus sp.—4 kinds at least

Bamboo
Barley
Buckwheat
Brush grass
Carob
Corn
Durra
Emmercorn
Job's tears
Kafir corn
Lotus
Manna grits
Millet (several kinds)
Oats
Quinoa
Ragi
Rice
Rye
Sorghum—6 kinds at least
Spelt
Teff
Teosinte
Tocusso
Wheat

Vegetables

Fl—flowers, R—roots. Unless part eaten is evident from name, stem or leaves are eaten, if no abbreviation follows:

Abutilon esculentus—Fl.
Adzuki bean
Angelica
Anise
Arracach
Arrow-head—R
Arrowroot
Artichoke
Leek
Lentil
Lettuce
Licorice—R
Lotus—R
Mauritius palm—stem
Mayna—R
Mitsuba—Stems

Asparagus
Balm
Bamboo
Basil
Bean, Bonavist
Bean, common
Bean, lima
Bean, mung
Bean, soy
Bean, string
Beet
Borage
Brussels sprouts
Cabbage
Cabbage palm
Caper—buds eaten
Cardoon
Carosella
Carrot
Cassava—R
Cat-tail—R
Cauliflower
Celeriac
Celery
Chard
Chayote
Chervil
Chick pea
Chicory
Chinese artichoke
Chinese cabbage—2 kinds
Chives
Clary
Corn-salad
Cress—3 or more species
Crosnes
Cucumber
Dandelion
Dasheen—R
Egg plant
Endives
Fennel
Fenugreek
Ferns—5 kinds—R
Garlic
Goa bean
Goosefoot
Guar bean
Horehound
Horseradish
Mustard
New Zealand spinach
Oca—R
Okra
Onion
Parsley
Parsnip
Pigeon pea
Pea, field
Pea, garden
Pepper
Phog—Fl.
Pokeberry
Pomme blanche
Potato
Potato bean
Pumpkin
Puya
Queensland arrowroot—R
Radish
Raisin tree—stems
Rape
Rhubarb
Rice bean
Risga—R
Rocambole—R
Rocket salad
Roselle—Fl.
Sago palm—pith
Salep—R
Salsify
Scorzonera
Scullion
Sea-kale
Shallot—R
Skirret—R
Snake gourd
Sorrels—5 kinds
Spinach
Squash
Sugar-cane
Sweet potato
Sword bean
Tahiti arrowroot
Takka—R
Tarragon
Tomato
Turnip
Tania—R
Udo—stems

Ice plant
Illipi—Fl.
Indian pea
Jerusalem artichoke—R
Kafir potato
Kale
Kohlrabi
Ulluco—R
Umara—R
Wax gourd
Winter purslane
Yam
Yam bean—R
Yautia—R

Nuts

Acorn
Almond
Araucaria nuts
Avellano
Beechnut
Black walnut
Brazil nut
Breadnut
Butternut
Candlenut
Caryocar spp.
Cashew nut
Catappa nut
Caucasian walnut
Chestnut
Chinquapin
Chufa
Earth-chestnut
"Edible acorn" 2 kinds (pasania spp.)
Filbert
Fox-nut
Ground nut (Voandzeia)
Ginkgo nut
Hazel nut
Hickory nut
Manketti nuts
Miriti nut
Nitta nut
Peanut
Pecan
Pili nut
Pine nuts—12 species
Pistachio nut
Queensland nut
Sapucaia nut
Shea-nut
Singhara nut
Souari nut
Tabebuia nut
Torrey nut
Walnuts—7 species
Water chestnuts—2 kinds
Wild almond
Wild bean
Yeheb nut

Fruits

Abiu
Akee
Anchovy pear
Apple
Apricot
Australian carissa
Avocado
Bael fruit
Banana
Barbardine
Blackberry
Blueberry
Brazilian guava
Breadfruit
Mangosteen
Marang
Maracujá melao
Marmalade plum
Medlar
Molucca—apple
Mombin
Mountain soursop
Mulberry
Muskmelon
Mytaceae—7 kinds at least
Nanche
Natal plum
Nectarine

Buffalo berry
Caimito
Canistel
Carambola
Caraunda
Casabanana
Cashew nut
Ceriman
Cherimoya
Cherry
Ciruela
Citron
Citrus fruits—11
Cocoa—plum
Coconut
Costa Rican guava
Crabapple
Cranberry
Currant—3 species
Custard-apple
Date
Diospyros spp.—4 species
Doum palm
Eugenia spp.—5 species
Fig
Feijoa
Gooseberry
Grape
Grape fruit
Guisaro
Gumixameira
Guava
Hagam
Hog plum
Huckleberry
Ilama
Icaco plum
Indian fig
Jaboticaba
Jack fruit
Jambolan plum
Jujube
Juneberries—25 species eaten
Kei apple
Kumquat
Lamsat
Lemon vine
Lemon
Leichee
Loganberry
Oleaster
Olive
Orange
Otaheite—apple
Palmyra palm
Papachi
Pepino
Papaya
Pasionaria
Passion fruit
Papaw
Pawpaw
Peach
Pear
Persimmon
Pineapple
Pitanga
Plantain
Plum
Pomegranate
Pond-apple
Prune
Pulassan
Quandong-peach
Queensland pomegranate
Quince
Rambutan
Raspberry
Rollinia spp.—6 kinds
Rose apple
Saguarro
Sapodilla
Seaside plum
Sebesten
Service-berry
Soncoya
Soursop
Spanish lime
Star apple
Strawberry
Strawberry guava
Strychnos fruit
Sugar apple
Surinam cherry
Sweet granadilla
Tamarind
Tangerine
Thimbleberry
Trebizond date
Tree tomato

Longan
Loquat
Madagascar plum
Malay apple
Mammey apple
Mango
Tuna
Water
White
Whort
Yang

In relation to the above list of food pl
sell of the U. S. Plant Introduction Bureau,

"I have listed about 200 fruits; this
not more than a third of all fruits used
peoples throughout the world, or perhaps
listed 142 vegetables; if we count all the pla
for greens and salads, and the many pla
occasionally eaten, I suspect that the numb
300. I have listed 70 kinds of nuts; this
same manner, be increased to 200, and the
if we take into account the native gras
chenopodiaceous plants used by the tribes
could be made 100. Thus we have as the t
plants:

Fruits ....
Vegetables ....
Nuts ....
Cereals ....

Total ....

THE ORIGINS OF FOOD P

The following condensed information c
of food plants is chiefly derived from de C
Cultivated Plants":

	Region Where
Almond	Mediterranean regic
Apple	Anatolia. Was know dwellers of Switz
Apricot	China
Arrow root	Tropical America
Asparagus	Europe, Western A
Avocado pear	Tropical America
Banana	Southern Asia
Barley	Western Asia
Bean	Region south of Ca America

Beetroot	Canary Islands
Bread-fruit	Sunda Isles
Buckwheat	Manchuria
Cabbage	Europe
Carob, St. John's bread	Syria
Carrot	Temperate Europe, Asia
Celery	Southern Europe, North Africa
Cherry	Caspian region
Chestnut	Southern Europe, North Africa, Japan, North America
Chick pea	Caspian region
Corn salad	Southern Europe
Cucumber	Northwest India
Currant	Europe, North India, United States
Date palm	Western Asia, Africa
Field pea	Italy
Fig	Syria
Gooseberry	Southern Europe, North Africa, Himalayas
Guava	Tropical America
Hickory nut	North America
Indian corn, maize	South America
Lemon	India
Lentil	Western Asia, Greece, Italy
Lettuce	Southern Europe, North Africa
Litchi nut	China
Mango	India
Manioc	Brazil
Melon	India, Guinea
Millet	Egypt, Arabia
Mulberry	Persia
New Zealand spinach	New Zealand
Oats	North of Caspian Sea
Oil-palm	Guinea
Okra	Tropical Africa
Olive	Syria
Onion	Persia, Palestine
Orange	China
Pawpaw	Tropical America
Papaw	America
Peach	China
Peanut	Brazil
Pear	Southern Europe, Asia
Persimmon	Eastern United States
Pineapple	Tropical America
Pistachio nut	Syria
Plum	Anatolia
Pomegranate	Persia
Potato	Peru
Quince	Persia

Quinoa	New Granada, Peru
Raspberry	Europe, Asia
Rice	India, China
Rye	Temperate Europe
Sesame	Sunda Isles
Sorghum	Tropical America
Spinach	Persia
Strawberry	Europe, Asia, North America
Sugar cane	China, Japan, Java
Sweet potato	Tropical America
Tomato	Peru
Turnip	Europe, Siberia
Walnut, Persian	Temperate Europe, Asia
Walnut, black	North America
Wheat	Region of Euphrates
Yam	China, Japan

MAKING THE BILL OF FARE

The making of the bill of fare is one of the greatest of all household responsibilities and should not be left to chance, individual whim or the gross ignorance of the average cook. It is a task for the woman who as wife and mother directs the household functions. It is never to be forgotten that we are made of what we eat. What we eat to-day will be walking about and talking to-morrow. Nature performs wonderful miracles in the transmutation of humble foodstuffs into sentient, forceful, intelligent human beings, a truly marvelous transfiguration; but even Nature must be supplied with raw material. And Nature herself does not undertake to make brass rods out of steel ingots, or muscles out of fat or starch. Quality is as important in foodstuffs as in fabrics. All is not gold that glitters. All is not food that fills the mouth or thrills the palate.

The construction of a bill of fare is a simple problem for an ape or a savage. The anthropoid knows instinctively what will satisfy his boy needs. The savage fills his stomach with what he finds, which, fortunately, is usually fairly well suited to his physiologic requirements, thanks to the fact that he is so close to Nature that his primitive tastes are still dominant and are a fairly safe guide to his fundamental needs, the means of gratifying which have been determined by the accumulated experiences of many generations.

But the civilized man has so completely lost his instinctive nutrition guides that he must take careful thought about his eating, being guided by the results of the thousands of laboratory experiments which have been made in State Experiment Stations and in nutrition laboratories.

Fortunately, the whole matter of diet has within recent years been so simplified by extended clinical experience that it is possible, by taking a little care and without the aid of elaborate calculations, to arrange a bill of fare for one's self or for a family that may be followed with full assurance of satisfaction and safety. It is necessary to give attention to eight items; viz., the amount of the food, the protein, the fats, carbohydrates, vitamins, salts (lime and iron) cellulose, and variety in the foodstuffs composing the menus.

1. *Amount of Food.* The amount of food must be adapted to individual needs. A slight excess is better than a deficiency.

In general, an average of 2500 calories each ordinary family, including two or three sma enough for an office man. Hard working m one chews his food thoroughly, the appetite as to quantity. The body weight should be

2. *The Protein.* If care is taken to quart of full milk daily and for each adult a three ounces of cottage cheese, or four to si further consideration need be given the que vided the diet comprises the usual variety vegetables. No meat, fish, fowl or shellfish eaten will simply burden the body with an ex must be eliminated as urea, throwing this ex kidneys. Eggs may be eaten sparingly in p inferior as a source of protein. Excess of most serious of all dietetic faults. Beans, l and milk are not needed at meals at which e must be strictly fresh to be safe and whole produced by fowls that are cared for in a given only clean food such as bran, butterm food. Cold storage eggs are a very inferio food.

One calory per pound of body weight pe tein needed to meet physiologic requiremen

3. *Fats.* Little thought need be give avoid taking too much. One-half, or at m ounce of butter at each meal is quite sufficie fat usually taken as seasoning in food and in is the least essential of the food elements. W digestion is delayed and colon putrefaction i three calories per pound of body weight per d all body needs. More than this may slowly obesity. When olive oil is freely used with the amount of butter eaten should be dimi there is a tendency to take on flesh.

4. *Carbohydrates.* Most of the carb taken in the form of whole grain prepar (Irish or sweet). Cane sugar should be us count of its irritating and somewhat toxic ch it is wholly lacking in lime, iron and vitamins foodstuffs should constitute the staples of foods which are relied upon to sustain the b

up steam in the vital engine. It is a mistake to depend too much upon breads and breakfast foods, because they lack vitamins and salts. Discard white bread for graham or bran bread. Use oatmeal or cornmeal with a liberal amount of bran added (an equal measure is not too much). The potato should be much more largely used than at present. When well cooked, it is the most quickly digested of all farinaceous foods.

The amount of carbohydrate needed is about 12 to 14 calories per pound of body weight daily. When the amount of work is increased, the carbohydrate ration should be increased in proportion. No increase in protein and little, if any, in fat is required.

The use of honey and of dates in place of cane sugar, to some extent, at least, is advisable. Malt sugar may well take the place of cane sugar for table use. The sugars made from corn by chemical processes do not deserve a place in a biologic bill of fare.

5. *Food Salts, Lime and Iron.* Care must be taken to provide an abundance of these essential blood-and bone-building elements, they are woefully deficient in most bills of fare. Lime is abundant in milk, greens, wheat, bran, beans, lentils, peas and some nuts (see Table XIII). Greens, bran, whole grains, malt sugar and gluten preparations are rich in iron, richer even than average meats. Egg yolks are rich in both lime and iron. Milk is very deficient in iron. Malted Nuts contains two and a half times as much iron as does milk. Some of these iron-and lime-rich foods should appear on every bill of fare (see Table XV). They are greatly neglected by the makers of menus. Children need more than adults; and nursing or expectant mothers need more than other adults.

6. *Vitamins.* To insure an adequate supply of the trio of vitamins, fresh, uncooked foods of some sort should be made a part of every meal. Unpasteurized milk supplies all the vitamins, as do also tomatoes (fresh or canned) raw cabbage, carrots and lettuce. On this account, one or more of these foods should appear daily on the bill of fare. (See Tables, XVII, XVIII, XIX, XX).

7. *Cellulose.* Roughage must be provided for every meal. Fresh fruit, greens, fresh vegetables, and especially bran or agar, in liberal quantities, should be used, not *daily* only, but at every meal. Each meal must have its due quantum of indigestible material to furnish a residue which will stimulate the colon to

pass it on to the exit, carrying with it the
secretions which so readily undergo putr
when allowed to stagnate. It is well to ad
cornmeal, or other cereal. Bran may be co
purées.

8. *Balancing the Bill of Fare.* A bal
contain not only the proper proportion of
bohydrates, and fats but also the essential
iron and other food salts with vitamins and
The most important thing, of course, is to m
cy of each one of the six essential food cons
teins, fats, carbohydrates, food salts, vitam
little excess of any one of these is really a m
consequence, and indeed no great harm cou
siderable temporary excess of any of the sev
with the exception of protein and fats. A
shown, an excess of protein lays a great an
upon the liver and kidneys which must tra
all of the excess as so much waste matter, n
able except in an incomplete way.

An excess of protein imposes another g
body by flooding the blood and tissue fluids
toxins which raise blood pressure, irritate an
and nerves, set up degenerative processes i
glands, cause changes in the blood vessels w
sclerosis, angina pectoris, apoplexy and o
and enormously increase the work of the ki
they are eliminated, wearing them out prem
ing the way for Bright's disease and gene
mature decay.

It is thus important to watch the
vigilance. Fortunately, the danger of an ex
tein almost wholly disappears when meat
flesh, and fowl) are eliminated from the bil
that a person when on a milk regimen take
excess of protein. One quart of milk will su
of protein required daily by a person of av
protein intake of a person who is receiving
milk a day is five or six times the amount o
make use. A considerable amount of the m
case is lost in the stools. Nevertheless, so g

sorbed that the taking of such a large amount of milk continuously for a considerable time is inadvisable since both the liver and the kidneys would be very decidedly overtaxed. In the case of a person whose weight has been considerably reduced by malnutrition, the excess of protein may be utilized in rebuilding the blood and the tissues until such time as the normal weight is regained. As has been elsewhere shown, the addition of a pint of milk, or even a smaller amount, to a bill of fare made up of fruits, grains, and vegetables will fully meet the body requirements for protein.

An excess of fat may do harm by delaying the movements of food along the alimentary canal, particularly prolonging the time of gastric digestion. An excess of fats also encourages putrefaction in the colon; hence an excess of fats should be avoided A deficiency can be easily compensated for by carbohydrates, so the only real danger is from excess. If the total intake of fats does not exceed two and one-half to three ounces there is little possibility of excess.

As regards the food salts and vitamins, there is no evidence whatever that any harm can possibly result from an excess; in fact, it is wise to make constant use of a superfluity of these elements by the free use of foods rich in salts so as to make sure of an abundant absorption of these essential elements.

As regards cellulose or roughage, there is a constant danger of a deficiency but no danger of an excess, provided always that the bulk is not so great as to overtax the capacity of the stomach.

9. *Variety.* The staples which furnish the bulk of the food value should be varied from day to day, and to these should be added as large a variety as can be reasonably secured, so as to make certain of securing a full complement of the various subtle elements needed for complete nutrition. The variety should not be great at a single meal, but the bill of fare should be varied from day to day.

Breakfast. This is too often a makeshift meal, affording little support for the day's labors. The fault does not lay altogether with the cook. The 7 o'clock dinner has spoiled the American breakfst. The late diner rises with little or no appetite, because his exhausted stomach is unprepared for a digestive task. A cup of coffee with a bit of toast and bacon or griddle cakes with corn sirup are the miserable substitutes for a real breakfast which is swallowed hurriedly by many thousands of business men.

Oatmeal with bran and cream, an egg or a glass of milk, fresh fruit, lettuce or celery, with bran bread and butter, will constitute a breakfast much more in harmony with physiologic requirements. For a vigorous man, a total of 800 calories will be needed to fortify the body for a good day's work.

Dinner. The heartiest meal should be taken at midday or at least not later than four or five p. m. The total number of calories at the midday meal may be 1000 to 1200.

Supper. Brain workers do much better to omit supper. Better sleep is secured and better digestion. If nourishment is needed at night, it is by all means best to confine the menu to fresh or stewed fruit with malt sugar, dates or raisins. A few nuts may be added if very well chewed and bran with rice, gruel or oatmeal porridge may be taken or some dextrinized cereal. The evening meal should be light; 500 to 700 calories should be sufficient when a substantial breakfast and a hearty dinner have been eaten.

The accompanying Diet Lists and Bills of Fare may serve as models by the aid of which suitable menus may be readily arranged for almost any patient or class of patients. By the addition of carbohydrates in the form of malt sugar, cereals or potatoes, the energy value or number of calories may be increased to meet the needs of almost any case requiring increase of flesh or a large out-put of energy in muscular work. The lime and iron content of the menu, as well as the protein, being sufficient to meet the needs of almost any possible case.

BILL OF FARE FOR FRUIT REGIMEN

						Per cent. of Day's Ration	
Breakfast	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Tomato broth	4¾	4	1	11	16		1
Grapefruit	3¾	3	2	44	49	3	2
Apple sauce	3½	1	3	72	76	2	3
Steamed figs	2	9	1	148	158	4	4
Lettuce	1¼	1	1	6	8	2	1
Lactose	2	0	0	200	200	0	0
Bran	½	11	6	26	43	2	8
Total		29	14	507	550	13	19
Dinner							
Vegetable bouillon	4¾	4	1	11	16	0	1
Turnip tops	3	7	51	9	67	41	20
Cauliflower	3	2	15	5	22	12	3
Celery	1¼	1	0	4	5	4	1
Strawberry jelly	3	0	0	120	120	1	1
Fruit nectar	5	2	2	96	100	1	1
Dates	1¾	4	13	160	177	4	11
Bran	½	11	6	26	43	2	8
Lactose	2	0	0	200	200	0	0
Total		31	88	631	750	65	46
Supper							
Savora broth	4¾	1	32	0	33	1	39
New beets	2¼	6	1	19	26	2	2
String beans	4	5	1	14	20	6	7
Sliced tomato	4	4	4	18	26	1	3
Pear sauce	4	3	4	93	100	2	2
Apple	5½	2	7	88	97	2	3
Bran	½	11	6	26	43	2	8
Loganberry juice-lactose	5¾	0	0	287	287	3	4
Total		32	55	545	632	19	68
Grand total		92	157	1683	1932	97	133

DIET LIST FOR FRUIT REGIMEN

Fruits: Fresh apples, oranges, grapefruit, dates, figs, raisins, all berries, plums, peaches, cantaloupes, watermelon, honeydew melon, osage melon, grapes, apricots, pears, pineapple, cherries, bananas, fruit sauces, fruit juices—orange, lemon, apple, grape, raspberry, blackberry, loganberry, etc.

Vegetables: (1) *Uncooked*—Tomatoes, celery, lettuce, endive, cabbage, cabbage (shredded), radishes.

(2) *Cooked*—Spinach, mustard, turnip tops, dandelion greens, red root, Swiss chard, dock, tomatoes, asparagus, potato gruel, vegetable broths, Savora broth.

Miscellaneous: Malt Sugar, Malt Honey, fig marmalade, prune marmalade.

Accessories: Bran, Laxa, agar, paraffin preparations (Paralax, Paramels, etc.).

Bran: 2 large tablespoonfuls each meal.

Cereal coffee (unroasted) without cream.

Acidophilus-Lactose to change the intestinal flora.

BILL OF FARE FOR ANTITOX

Breakfast	Oz.	Pro.	Fat	Car
Cantaloup	6½	4	0	6
Stewed raisins	3	6	17	17
Brose	4¼	10	8	3
Cream	2¼	7	111	1
Graham gems	3	27	46	13
Malt honey	2¼	0	0	19
Cereal coffee				
Bran	¼	5	3	1
Total		59	175	63
Dinner				
Vegetable soup with noodles	4¾	3	19	2
Baked sweet potato	6	12	10	18
Buttered asparagus	3	6	94	1
Swiss chard—lemon	3	7	51	
Cabbage salad	2	4	37	1
Bran bread	2	12	64	12
Butter	½	0	113	
Yogurt buttermilk	6	24	5	3
Watermelon	8	3	4	7
Bran	¼	5	3	1
Total		76	400	49
Supper				
Okra soup	4¾	2	1	
Baked cornlet	3	13	91	
Shredded carrot—lemon	2	3	2	
Whole wheat bread	2	22	4	1
Butter	½	0	113	
Blackberries	3	5	8	
Bran	¼	5	3	
Total		50	222	2
Grand total		185	797	14

ANTITOXIC DIET LIS

Soups: Vegetable soups and bouillons.

Relishes: Tomatoes, celery, lettuce, endive, sliced cabbage, shredded carrots and t mose, Meltose, Meltose with butter. S

Vegetables: All vegetables.

Cereals: Brose (scalded oatmeal), cereal fla Shredded Wheat, Granola, macaroni, c

Breads: Graham at least 24 hours old. bran gems, gluten bread.

Beverages: Fruit juices, cereal coffee, M Milk, buttermilk (Yogurt, acidophilus).

Fruits: All fresh and cooked fruits.

Desserts: Fruit tapioca, fruit gelatines, fr Fig Marmalade, Prune Marmalade, dat

Miscellaneous: Butter, cream, buttermilk, nuts, Malted Nuts, Malted Milk, Proto

Accessories: Bran, agar, Laxa, Paralax, paraffin preparations, Acidophilus-Lact

BILL OF FARE FOR LOW PROTEIN DIET

						Per cent. of Day's Ration	
Breakfast	**Oz.**	**Pro.**	**Fat**	**Carbo.**	**Total**	**Lime**	**Iron**
Orange	5	5	3	66	74	7	2
Blueberries	2¼	2	3	42	47	1	4
Cream of wheat	4	6	1	42	49	7	8
Cream	2¼	7	111	12	130	7	1
Malt sugar	1¾	0	8	210	218	3	18
Graham toast	1	10	6	52	68	1	5
Butter	¼	0	56	0	56		
Yogurt buttermilk	6	24	5	36	65	28	3
Bran	¼	5	3	13	21	1	4
Total		59	196	473	728	55	45
Dinner							
Celery soup	3	1	8	7	16		
Baked potato	3	9	1	78	88	1	8
Spinach	3	7	51	9	67	7	23
New beets	2	3	14	21	38	2	2
Waldorf salad	2¼	8	55	29	92		
Bran bread	1	6	32	62	100	1	5
Butter	½	0	113	0	113		
Golden nectar	3½	1	1	64	66	1	1
Cantaloup	6½	4	0	69	73	5	4
Pecans	½	6	94	9	109	1	2
Yogurt buttermilk	6	24	5	36	65	28	3
Bran	¼	5	3	13	21	1	4
Total		74	377	397	848	47	52
Supper							
Potato soup	4¾	5	16	38	59		
Stuffed tomato	5	10	38	55	103	1	5
Lettuce	1¼	1	1	6	8	2	1
Bran bread toast	1	6	32	52	100	1	5
Butter	¼	0	56	0	56		
Yogurt buttermilk	6	24	5	36	65	28	3
Apple	5½	2	7	88	97	2	3
Bran	¼	5	3	13	21	1	4
Total		53	158	288	509	35	21
Grand total		186	731	1158	2085	137	118

LOW PROTEIN DIET LIST

Fruits: All fruits and fruit juices. Chestnuts and litchi nuts (Avoid other nuts and olives). Figs, prunes and dates.

Vegetables: All green vegetables, especially fresh vegetables, greens and salads.

Cereals: Rice, barley and rice flakes.

Miscellaneous: Butter, olive oil, honey, Malt Sugar, Malt Honey, Malted Nuts, buttermilk (one-half pint daily).

Accessories: Bran, agar, Laxa and paraffin preparations. Acidophilus-Lactose.

When a very low-protein diet is required as in certain cases of nephritis, the diet must be confined to malt sugar and fruit juices.

BILL OF FARE FOR PROTEIN-F

7 A. M.	Oz.	Pro.	Fat	Car
Sliced oranges	5	5	3	
Banana purée	3½	5	6	
Rice gruel	3½	2	1	
Celery	1¼	1	0	
Meltose with butter	1½	0	94	
Cereal coffee				
Cream	1	3	49	
Agar				
Total		16	153	2
11 A. M.				
Potato broth	3	3	10	
Lettuce—lemon	1¼	1	1	
Loganberry juice	3¼	0	0	
Fresh peaches	4	4	1	
Malt sugar	2	0	0	2
Agar				
Total		8	12	3
3 P. M.				
Vegetable bouillon	4¼	12	1	
String beans	4	5	1	
Stewed tomatoes	2½	4	1	
Mustard greens	3	7	51	
Cantaloup	6½	4	0	
Apple juice	6	0	0	1
Dates	1¾	4	13	1
Agar				
Total		36	67	3
7 P. M.				
Savora broth	4¼	1	32	
Swiss chard	3	7	51	
Fresh peas	4	3	5	
Blueberry juice	6	0	0	1
Malt sugar	2	0	0	2
Agar				
Total		11	88	37
Grand total		71	320	13

PROTEIN-FREE DIET LI

All fruit juices, peaches, pears, apples, b
sugar (Meltose), Malt Honey, raisin juice, co
oatmeal water, vegetable broths, lactose,
whey. Greens of all sorts, celery, lettuce, t
Litchi nuts.

BILL OF FARE FOR FEVER

						Per cent. of Day's Ration	
7 A. M.	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Rice gruel	4¾	2	1	25	28		1
Malt sugar	1	0	0	100	100	2	9
Cream	2¼	7	111	12	130	7	1
Cream toast	5	25	53	83	161	17	7
Orange juice	2½	0	0	39	39	3	4
Total		34	165	259	458	29	22
9 A. M.							
Milk	6	23	66	35	124	29	3
Lactose or Acidophilus-Lactose	2	0	0	200	200		
11 A. M.							
Savora broth	4¾	1	32	0	33	2	39
Mashed potato	3¼	9	15	61	85	1	9
Spinach purée	3	7	51	9	67	7	23
Grape juice	3¾	0	0	83	83	1	2
Baked custard	3¼	17	45	51	113	14	9
Total		34	143	204	381	25	82
1 P. M.							
Milk	6	23	66	35	124	29	3
Lactose or Acidophilus-Lactose	2	0	0	200	200		
3 P. M.							
Yogurt buttermilk	6	24	5	36	65	28	3
5 P. M.							
Strained vegetable soup	4¾	2	19	17	38		
Barley gruel	4	4	2	31	37	1	5
Malt sugar	1	0	0	100	100	2	9
Lemonade with lactose (2 oz.)	6	0	0	200	200		
Pineapple sherbet	3½	5	2	119	129	2	3
Total		11	23	467	504	5	17
Grand total		149	468	1436	2056	145	130

FEVER DIET LIST

Fruits: Purées and juices of all sorts, especially orange juice, fig and prune marmalades (Meltose).

Cereals: Gruel and porridge of all cereals, cereal flakes, Granola, graham toast, all dextrinized cereals, Lacto-Dextrine, Granose Biscuit, Shredded Wheat.

Vegetables: Purées of all vegetables, potato soup, vegetable soup, cream of corn soup, purées of spinach and other greens, vegetable broths.

Miscellaneous: Buttermilk (acidophilus), whey, malt sugar (Meltose). Malt Honey, Malted Nuts, Malted Milk, Meltose, Marmalades (fig, prune), Savora broth, gluten mush (40%), cream gluten gruel, lactose, Acidophilus-Lactose.

Accessories: Bran, (except in typhoid), agar, Laxa, paraffin (Paramels, Paralax, petrolatum, etc.)

BILL OF FARE FOR LAXATI

Breakfast	Oz.	Pro.	Fat	Ca
Orange juice	5	0	0	
Stewed prunes	3¾	3	1	
Brose	4¼	10	8	
Cream	2¼	7	111	
Bran gems	2	16	67	
Butter	½	0	113	
Cereal coffee				
Lettuce	1¼	1	1	
Total		37	301	
Dinner				
Tomato soup	4¾	6	22	
Baked potato	3	9	1	
Beet greens	3	7	51	
String beans	4	5	1	
Sliced cucumbers	2	2	1	
Cottage cheese	1	20	12	
Bran bread	2	12	64	
Butter	½	0	113	
Apple and date salad	2½	4	8	
Lemon jelly, whipped cream	3½	1	23	
Bran	¼	5	3	
Total		71	299	
Supper				
Vegetable consomé	4¾	12	1	
Asparagus on toast	3	14	85	
Shredded carrots	2	3	2	
Celery	1¼	1	0	
Graham bread	2	20	12	
Butter	½	0	113	
Pecans	½	6	94	
Grapes	5	6	16	
Yogurt buttermilk	6	24	5	
Bran	¼	5	3	
Total		91	331	
Grand total		199	931	1

LAXATIVE DIET LIS

All foods rich in cellulose (See Tables

Fruits: All fruits, especially fresh figs, d (soaked), figs purée, prunes, prune pu lades, tomatoes, berries and nuts.

Cereals: Oatmeal, Brose (cooked only 6 to wheat, whole wheat, Cooked Bran, bran bran bread, bran muffins, Shredded whe

Vegetables: Carrots, turnips, rutabagas, ach, dandelion and other greens, strin egg-plant, celery, lettuce, cucumber, radi

Miscellaneous: Malt sugar (Meltose), Malt Malted Milk, buttermilk (acidophilus,

Accessories: Agar, Laxa, paraffin preparati lax, petrolatum, etc.), Acidophilus-Lact

BILL OF FARE FOR FATTENING DIET

						Per cent. of Day's Ration	
Breakfast	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Grapefruit	3¾	3	2	44	49	3	2
Steamed rice with raisins	4½	15	7	171	193	3	6
Malt Sugar	2	0	0	200	200	3	18
Cream	2¼	7	111	12	130	7	1
Baked potato	3	9	1	78	88	1	3
Celery	1¼	1	0	4	5	4	1
Bran gems toasted	2	16	67	55	138	2	10
Butter	½	0	113	0	113		
Cereal coffee							
Bran	¼	5	3	13	21	1	4
Total		56	304	577	937	24	50
Dinner							
Cream of pea soup	4¾	12	33	25	70	6	
Mashed potato	3¼	9	15	61	85	1	9
Mustard greens	3	7	51	9	67	89	28
Creamed carrots	3¾	9	41	36	86	4	2
Yogurt buttermilk	6	24	5	36	65	28	3
Bran bread	2	12	64	124	200	2	10
Butter	½	0	113	0	113		
Meltose	2¼	0		193	193	2	7
Baked apple	4½	1	3	82	86	1	2
Pecans	½	6	94	9	109	1	2
Bran	¼	5	3	13	21	1	4
Total		85	422	588	1095	135	67
Supper							
Savory potato soup	4¾	2	27	20	49	1	35
Cereal flakes	1	11	1	92	104	0	0
Cream	2¼	7	111	12	130	7	1
Whole wheat bread	2	22	4	112	138	2	6
Butter	½	0	113	0	113		
Fresh strawberries	4	15	6	34	55	5	4
Malt sugar	1	0	4	120	124	2	9
Bran	¼	5	3	13	21	1	4
Total		62	269	403	734	18	59
Grand total		203	995	1568	2766	177	176

FATTENING DIET LIST

Fruits: All fruits, but especially dates, figs, avocadoes, ripe olives.

Nuts: All nuts, especially, almonds, walnuts, pecans and peanuts, peanut butter, almond cream.

Milk: Certified milk, cream, butter, buttermilk, cottage cheese, cream cheese, clotted cream, malted milk.

Cereals: All cereals, especially rice, Granola and other dextrinized cereals, breads, zwieback, mushes, etc.

Vegetables: Potatoes, sweet potatoes, greens.

Miscellaneous: Malted Nuts, malt sugar (Meltose), lactose, lactose-dextrine, Acidophilus-Lactose.

Accessories: Laxa, agar, paraffin preparations (Paralax, Paramels, petrolatum).

BILL OF FARE FOR RESTORATIV MAKING DIET

Breakfast	Oz.	Pro.	Fat	Car
Orange juice	5	0	0	7
Oatmeal with dates (1 oz.) ..	5	14	17	14
Cream	2¼	7	111	1
Bran bread toast	2	12	64	1
Butter	½	0	113	
Cereal coffee				
Bran	¼	5	3	1
Total		38	308	3
Dinner				
Savora rice soup	4¾	4	16	
Scalloped potatoes	4¼	16	57	
Mustard greens—2 egg yolks ..	4	25	131	
Slicel tomatoes	4	4	4	1
Yogurt buttermilk	6	24	5	
Bran bread	2	12	64	1
Butter	½	0	113	
Fresh strawberries	4	5	6	
Malt sugar	1	0	0	1
Bran	¼	5	3	1
Total		95	399	4
Supper				
Lentil soup	4¼	35	19	
Baked potato	3	9	1	
Lettuce sandwich	2	12	123	
Ripe olives	1¼	2	92	
Raspberries	4	5	0	
Malt Honey	2¼	0	0	1
Bran	¼	5	3	
Total		68	238	5
Grand total		201	945	13

RESTORATIVE OR BLOOD-MAKI

This dietary includes most foods rich in (See Tables XII, XIV, XV), especially whol graham bread, cracked wheat, oatmeal, b flakes, Shredded Wheat, gluten biscuit, glute (40%), beans, lentils, peas, soy beans, to tops, lettuce, salads, milk, cream, whey, cheese, malt sugar (Meltose), Malt Honey, vegetable broths, tomatoes, tomato juice, juice, eggs, egg yolks, nuts of all sorts, date

It is not necessary that the diet should to the above foods, but they should constitu dietary, so as to make sure of an abundant iron, lime and other food salts. When the the iron and lime content of the food should deficiency is made good. That is, the per c tion of these elements should be 200.

BILL OF FARE FOR REDUCING DIET

						Per cent. of Day's Ration	
Breakfast	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Sliced orange	5	5	3	66	74	7	2
Banana	3½	5	5	90	100	1	4
Bran mush	4¼	18	13	55	86	7	25
Milk (skimmed)	6	24	5	36	65	28	3
Bran bread toast	1	6	32	62	100	1	5
Butter	¼	0	56	0	56		
Celery	1¼	1	0	4	5	4	1
Total		59	114	313	486	48	40
Dinner							
Vegetable bouillon	4¾	12	1	1	14		
Beet greens	3	7	51	9	67	7	22
Jerusalem artichokes	3	8	94	50	152		
Stewed tomatoes	2½	3	1	11	15	1	3
Sliced cucumbers	2	2	1	7	10	1	
Yogurt buttermilk	6	24	5	36	65	28	3
Gluten bread	1	28	12	32	72		
Fresh strawberries	4	5	6	34	45	7	7
Bran	¼	5	3	13	21	1	4
Total		94	174	193	461	45	36
Supper							
Savora broth	4¾	1	32	0	33	2	39
String beans	4	14	58	32	104	7	9
Chopped cabbage-lemon	2	6	2	21	29	4	4
Sliced tomato	4	4	4	18	26	1	3
Graham bread	1	10	6	52	68	1	5
Fresh peaches	4	4	1	46	51	2	2
Bran	¼	5	3	13	21	1	4
Total		44	106	182	332	18	66
Grand total		197	394	688	1279	111	142

REDUCING DIET LIST

Fruits: All fresh, juicy fruits, especially acid and sub-acid fruits. Avoid figs, dates, raisins and prunes. Also avoid nuts.

Cereals: Bran mush (bran 3 parts by measure, rolled oats 1 part. Cook 6 minutes), Bran bread toasted, 1 slice at each meal, or rye bread toasted. Gluten bread (40%), gluten gems, and gluten biscuit instead of ordinary bread. Avoid "breakfast foods," flakes and dextrinized cereals.

Vegetables: Most vegetables, especially the artichoke, the Jerusalem artichoke, greens of all sorts, turnips, cabbage, celery, lettuce, cucumber, radish, salsify,. Brussels sprouts, and avoid the potato, sweet potato and the dasheen.

Miscellaneous: Whey, cottage cheese, skimmed milk, buttermilk (Yogurt, acidophilus), butter (1/2 ounce daily), cereal coffee.

Accessories: Laxa, agar, Paralax, Paramels and other paraffin preparations.

BILL OF FARE FOR DRY

Breakfast	Oz.	Pro.	Fat	C
Cereal flakes	1	11	1	
Cream	2¼	7	111	
Steamed figs	2	9	1	
Whole wheat bread toast	2	22	4	
Butter	½	0	113	
Bran	¼	5	3	
Total		54	233	
Dinner				
Baked potato	3	9	1	
Spinach	3	7	51	
Cottage cheese	2	40	25	
Bran bread toast	2	12	64	
Butter	½	0	113	
Baked apple	4¼	1	3	
Bran	¼	5	3	
Total		74	260	
Supper				
Bran mush	4¼	18	13	
Cream	2¼	7	111	
Lettuce	1¼	1	1	
Popped corn	1	13	21	
Dates	2	5	15	
Total		44	161	
Grand total		172	654	

DRY DIET LIST

Toasted cereal flakes, browned rice, p
breakfast toast, dry toast, toasted Whole
ola, Granuto, corn breads, baked potato,
spinach soufflé, baked cornlet, popped co
mose, Malted Nuts, Meltose (Malt Honey
Sanitas Meat, yolks of hard boiled eggs,
apples, prune marmalade, bananas, raisi
sterilized butter, cream, cottage cheese, fig

Most ordinary foods may be used with
soups, milk and other beverages and jui
vegetables.

BILL OF FARE FOR FRESH OR RAW DIET

						Per cent. of Day's Ration	
Breakfast	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Grapefruit	3¾	3	2	44	49	3	2
Banana	3½	5	6	90	101	1	4
Oatmeal (scalded)	4¼	13	11	53	77	3	7
Milk	6	23	66	35	124	28	3
Pecans	1	12	188	18	218	2	4
Celery	2	3	0	8	11	6	2
Bran	¼	5	3	13	21	1	4
Total		64	276	261	601	44	26
Dinner							
Apple juice	6	0	0	102	102	1	2
Chopped cabbage-lemon	2	6	2	21	29	4	4
Sliced tomato	4	4	4	18	26	1	3
Green corn	5½	20	16	126	162	1	8
Fresh strawberries	4	5	6	34	45	7	7
Black figs	2	1	16	173	190	11	13
Almonds	1	24	146	20	190	4	8
Bran	¼	5	3	13	21	1	4
Total		65	193	507	765	30	49
Supper							
Milk	6	23	66	35	124	28	3
Shredded carrots	2	3	2	22	27	2	2
Sliced cucumber	2	2	1	7	10	1	
Radishes	2	3	1	13	17	2	2
Lettuce-lemon	1¼	1	1	6	8	2	1
Dates	2	5	15	183	203	5	11
Walnuts	1	21	164	15	200	4	4
Raspberries	4	5	0	59	64	8	4
Bran	¼	5	3	13	21	1	4
Total		68	253	353	674	53	31
Grand total		197	722	1121	2040	127	106

FRESH OR RAW DIET LIST

Fruits of all sorts and fruit juices.

Lettuce, celery, radish, cucumber, cabbage (uncooked), carrot, turnip, tomato.

Certified milk, whey, buttermilk (Yogurt, acidophilus), eggnog (yolks).

Brose (oatmeal scalded), Bran Brose (oatmeal and bran equal parts, cooked six minutes) green corn (uncooked).

Nuts, especially almonds, hazelnuts or filberts, walnuts and pecans. Malt sugar may be used with acid fruits.

BILL OF FARE FOR HYPERCHLORHYDRIA

						Per cent. of Day's Ration	
Breakfast	**Oz.**	**Pro.**	**Fat**	**Carbo.**	**Total**	**Lime**	**Iron**
Olive oil	¼	0	66	0	66		
Cream of wheat	4¼	6	1	12	49	7	8
Cream	2¼	7	111	12	130	7	1
Malt sugar	1	0	4	120	124	2	9
Prune purée	3¾	3	1	99	103	2	6
Bran bread toast	2	12	64	124	200	2	10
Butter	½	0	113	0	113		
Agar							
Total		28	360	397	785	20	34
Dinner							
Olive oil	¼	0	66	0	66		
Lentil soup	4¾	35	19	86	140	3	14
Stuffed potato	3½	9	30	66	105	3	8
Spinach purée	3	7	51	9	67	7	23
Whole wheat toast	2	22	4	112	138	2	6
Butter	½	0	113	0	113		
Yogurt buttermilk	6	24	5	36	65	28	3
Blueberries	2¼	2	3	42	47	1	4
Agar							
Total		99	291	351	741	45	62
Supper							
Olive oil	¼	0	66	0	66		
Cream of potato soup	4¾	12	38	53	103	1	3
Mashed carrots	3	4	4	33	41	7	3
Turnip top purée	3	7	51	9	67	41	20
Graham bread toast	2	20	12	104	136	2	10
Butter	½	0	113	0	113		
Fresh pear	4	3	5	66	74	2	2
Total		46	289	265	600	63	38
Grand total		173	940	1013	2126	128	134

DIET LIST FOR HYPERCHLORHYDRIA

Soups: Plain and cream vegetable soups.

Relishes: Tender celery, lettuce with olive oil, ripe olives.

Entrees: Macaroni and spaghetti (buttered, creamed or with egg sauce), soft cooked eggs (poached or boiled), Protose. Nuttolene.

Vegetables: Purées of corn, peas, greens, beets, carrots, beans, oyster plant, squash, asparagus, soy beans, potatoes.

Cereals: All flakes, cream of wheat, shredded wheat, oats, cornmeal, hominy, gruels of all kinds, bran.

Breads: Dextrinized breads such as rice biscuit, granose biscuit, browned rice, zwieback, granola, thin crisp toast, Vita bread.

Fruits: Sweet apples, dates, fresh pears, blueberries, very ripe bananas, white cherries, cantaloup, malaga or tokay grapes.

Beverages: Buttermilk with cream, milk and cream, malted milk, Malted Nuts, unsweetened egg nogs (made with yolks only), unsweetened cocoa and Minute Brew.

Desserts: Custards (slightly sweetened), ices and sherbets, jellies made with bland fruit juices, ice cream, frozen cream and fluffs made with sub-acid fruits.

Miscellaneous: Pecans, pinenuts, cream, butter, Malt Honey, with butter, olive oil, bromose, malted nuts, cottage cheese with cream. Yogurt cheese.

This dietary should consist of foods which require little mastication and all irritating and stimulating foods should be eliminated.

Accessories: Bran, Laxa, Colax, Agar, Paraffin Oil, Paralax, Paramels.

BILL OF FARE FOR ULCER DIET

						Per cent. of Day's Ration	
Breakfast	Oz.	Pro.	Fat	Carbo.	Total	Lime	Iron
Rice gruel	3½	2	1	25	28		1
Soft poached egg yolk	1	18	80	0	98	11	20
Oven baked toast (moistened)	1	10	6	52	68	1	5
Butter	¼	0	113	0	113		
Date purée	2	5	15	183	203	5	11
Total		35	215	260	510	17	37
10 A. M.							
Milk 1/3 cream	6	21	143	34	198	26	3
Dinner							
Cream of lentil soup	4¾	44	80	97	221	8	14
Spinach soufflé	3	25	78	146	249	10	10
Carrot purée	3	5	19	31	55	7	3
Oven-baked toast (moistened)	1	10	6	52	68	1	5
Butter	½	0	113	0	113		
Malted milk	1½	20	14	132	166	2	2
Total		104	310	458	872	28	34
4 P. M.							
Milk ⅓ cream	6	21	143	34	198	26	3
Supper							
Potato soup	4¾	5	16	38	59		
Peas purée	3	19	24	52	95	4	11
Rice biscuit	1	9	1	97	107		
Butter	½	0	113	0	113		
Banana purée	3½	5	5	87	97	1	4
Malt sugar	2	0	0	200	200	3	18
Total		38	159	474	671	8	33
Grand total		219	970	1260	2449	105	110

ULCER DIET LIST

Soups: Strained cream soups of vegetables, such as peas, beans, asparagus, potato, corn, rice and oatmeal.

Vegetables: Purées of vegetables such as spinach, peas, asparagus, beets, carrots, corn, celery, and egg plant. Mashed or baked potato.

Cereals: Rice flakes, wheat flakes, crea
soft buttered toast, cream gluten mush
cereals.

Breads: Toasted bread, Granose and Ric

Beverages: Malted Nuts, Malted Milk, c
ophilus buttermilk, with cream, unswe
with yolks only).

Fruits: Banana purée, date purée, bake
banana, avocado.

Desserts: Frozen cream, unsweetened cus
from bland fruit juices.

Miscellaneous: Olive oil, butter, cream,
tage cheese with cream, yogurt chees

Accessories: Agar, bran, paraffin oil.

BILL OF FARE FOR MODIFIED

Breakfast	Oz.	Pro.	Fat
Olive oil	¼	0	66
Oatmeal	5	11	9
Cream	2¼	7	111
Banana purée	3½	5	6
Soft poached egg	1½	23	40
Graham toast	2	20	12
Cereal coffee			
Agar			
Total		6	244
Dinner			
Olive oil	¼	0	66
Cream of rice soup	4¾	11	40
Baked potato	3	9	1
Carrot purée	3	4	4
Beet green purée	3	7	51
Yogurt buttermilk, ⅓ cream	6	22	102
Bran bread toast	2	12	64
Butter	½	0	113
Baked sweet apple	4¼	1	3
Agar			
Total		66	444
Supper			
Olive oil	¼	0	66
Gluten mush	5½	18	2
Date purée	2	5	15
Cottage cheese	2	40	25
Blueberries	2¼	2	3
Whole wheat bread toast	2	22	4
Butter	½	0	113
Total		87	228
Grand total		219	916

BILL OF FARE FOR HYPOCHLORHYDRIA

						Per cent. of Day's Ration	
Breakfast	**Oz.**	**Pro.**	**Fat**	**Carbo.**	**Total**	**Lime**	**Iron**
Grapefruit	3¾	3	2	44	49	3	2
Steamed rice	4	13	1	113	127		2
Tomato sauce	3	6	54	20	80	1	3
Lettuce	1¼	1	.1	6	8	2	1
Granose biscuit	1	14	2	84	100		
Butter	¼	0	56	0	56		
Cereal coffee							
Bran	¼	5	3	13	21	1	4
Total		42	119	280	441	7	12
Dinner							
Savora rice soup	4¾	4	16	33	53	2	39
Stuffed potato	3½	9	30	66	105	3	8
Carrots	3	4	4	33	41	7	3
Green corn	2¾	9	8	59	76	1	4
Celery	1¼	1	0	4	5	4	1
Yogurt buttermilk	6	24	5	36	65	28	3
Bran bread toast	2	12	64	124	200	1	3
Butter	¼	0	56	0	56		
Fresh strawberries	4	5	6	34	45	7	7
Malt sugar	2	0	0	200	200	3	18
Bran	¼	5	3	13	21	1	4
Total		73	192	602	867	57	90
Supper							
Protose broth	4¾	12	1	1	14		
Breaded tomatoes	3½	7	15	32	54	1	3
Wax beans	4	5	1	14	20	6	7
Cottage cheese	2	40	25	10	75	56	4
Whole wheat bread toast	2	22	4	112	138	2	6
Butter	¼	0	56	0	56		
Orange jelly	3	0	0	120	120	1	
Bran	¼	5	3	13	21	1	4
Total		91	105	302	498	67	24
Grand total		206	416	1184	1806	131	126

DIET LIST FOR HYPOCHLORHYDRIA

Soups: Clear vegetable broths and cream vegetable soups.

Relishes: Ripe olives, celery, lettuce, endive and watercress.

Entrees: Macaroni, spaghetti and soft cooked eggs.

Vegetables: Baked, mashed or stuffed potatoes, asparagus tips, tender string or wax beans, spinach finely chopped, new peas, beets purée, tomatoes, corn, carrots and purée of navy and lima beans.

Cereals: Flakes, "Pep" Granola, Cream of Wheat, Shredded Wheat, rolled oats, oatmeal with bran, hominy grits, rice and cornmeal mush.

Breads: Dry toast (whole wheat, bran, graham), zwieback, saltines, graham wafers, soda, butter or water crackers.

Fruits: All fresh and cooked fruits. Acid
indicated.

Beverages: Koumiss, Malted Nuts, malt
Minute Brew and health cocoa.

Desserts: Custards, tapioca, gelatines, frui
ices and sherbets.

Miscellaneous: Avoid pickles, condiments
also an excess of fat and rich heavy foo
meat broths and extracts.

Those who have little or no hydrochlo
ticate their food thoroughly. An abun
should be used. Simply prepared and
should make up the dietary and not to
dulged in at one meal. The intestinal f
and the protective flora kept dominan
constant use of lactose or Acidophilu

BILL OF FARE FOR ACHYLIA

Breakfast	Oz.	Pro.	Fat	C
Orange juice	5	0	0	
Baked apple	4¼	1	3	
Malt sugar	2	0	0	
Brose	4¼	10	8	
Cream	2¼	7	111	
Graham bread toast	2	20	12	
Lettuce-lemon	1¼	1	1	
Bran	¼	5	3	
Total		44	138	
Dinner				
Tomato soup	4¼	6	22	
Mashed potato	3¼	9	15	
Asparagus tips	1¼	4	15	
Yogurt buttermilk	6	24	5	
Celery	1¼	1	0	
Bran bread toast	2	12	64	1
Pear	4	3	5	
Bran	¼	5	3	
Total		64	129	3
Supper				
Savora broth	4¼	1	32	
Cottage cheese	2	40	25	
Sliced tomatoes	4	4	4	
Bran biscuits	1	20	23	
Steamed rice	4	13	1	1
Cream	2¼	7	111	
Grapes	5	6	16	
Bran	¼	5	3	
Malt sugar	2	0	0	2
Total		96	215	5
Grand total		204	482	13

DIET LIST FOR ACHYLIA

Soups: Plain vegetable soups and purées.

Relishes: Celery, lettuce, endive and watercress.

Entrees: Soft cooked eggs, macaroni, spaghetti, Protose and Nuttolene.

Vegetables: Irish potatoes, peas, navy, lima, kidney, soy, wax and green beans, tomatoes, greens of all kinds, egg plant, carrots, squash, corn, beets, artichokes and asparagus.

Cereals: Rice, Shredded wheat, Brose, farina, rolled oats, cereal flakes, bran and other cereal preparations, with breads.

Fruits: All fresh and cooked fruits.

Beverages: Fruit juices, Malted Milk, Malted Nuts, Minute Brew, cocoa, buttermilk and Yogurt buttermilk.

Desserts: Gelatine custards, ices, sherbets, plain cakes and tapioca.

Miscellaneous: Cottage cheese, Yogurt cheese, Meltose (Malt Honey), honey, butter and cream in restricted quantities.

Accessories: Bran, Agar, and paraffin preparations should be used regularly with each meal, also acid protein (Acidone) when free acid is wholly absent or nearly so.

The food must be thoroughly masticated and the dietary kept laxative by the use of bulky foods such as fresh fruits, vegetables and greens. Acid fruits should be freely used, also fruit juices. The intestinal flora should be changed frequently by the use of lactose or Acidophilus-Lactose.

TABLE XLIV.

Showing the Food Value (Calories) per Ounce of Common Foods and Prepared Dishes as Served.*

(The letters E. P. signify, edible portion; A. P., as purchased).

	Protein	Fats	Carbo.	Total
Albumin Water	2.9	.1	....	3.0
Almonds	23.8	139.9	19.6	183.3
Almond Apple	3.0	16.1	32.4	51.5
Cream	5.2	30.6	4.3	40.1
Cream, Frozen	13.0	76.4	10.7	100.1
Ice	4.4	23.5	3.3	31.2
Ice Cream	3.5	29.3	9.7	42.5
Sandwich	12.4	40.4	47.9	100.7
Soup, Cream of	6.2	28.9	13.9	49.0
Wafers	18.0	102.4	59.5	179.9
Alpine Eggs	16.5	40.8	1.0	58.3
Angel Food Pudding	7.4	19.1	44.5	71.0
Apple, Fresh	.5	1.3	16.1	17.9
Baked	.4	1.1	31.7	33.2
and Date Fluff	1.7	2.9	36.1	40.7
and Date Salad	1.9	11.4	32.4	45.7
Fritters	4.3	32.9	32.3	69.5
Honey	.6	8.6	26.9	36.1
Jelly	....	....	64.5	64.5
Jelly Sandwich	5.9	35.6	53.9	95.4
Juice	....	....	17.0	17.0
Lemon	.5	4.6	26.7	31.8
Maple	.4	1.1	44.7	46.2
Pie	2.5	22.1	40.9	65.5
and Nut Pie	8.7	16.0	28.0	52.7
Cream Pie, New England	2.7	19.8	24.0	46.5
with Rolled Oats	2.9	3.4	43.8	50.1
Sauce	.3	.9	26.9	28.1
Sauce Cakes	3.2	23.9	61.8	88.9
Snow	1.9	1.1	20.7	23.7
Snowballs	1.0	.4	13.2	14.6

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* The caloric values of the cooked foods named in this table are calculated from the formulas or recipes given in "The New Cookery," by Miss Lenna Cooper, A. B., the Battle Creek School of Home Economics.

	Protein	Fats	Carbo.	Total
Tapioca Pudding	.3	.7	20.3	21.3
Tart	2.0	16.5	34.6	53.1
Toast	5.7	.9	36.7	43.3
Whip	3.8	.7	17.9	22.4
Apricots, Fresh	1.2	....	15.2	16.4
A la Conda	.9	2.0	54.6	57.5
Canned	.8	....	40.7	41.5
Fluff	2.9	5.3	52.9	61.1
Gelee	.6	....	18.9	19.5
Hydrated (Stewed)	1.9	.9	46.4	49.2
Jellied	.8	....	31.3	32.1
Salad	4.1	67.3	13.0	84.4
Sandwiches	6.8	29.0	58.3	94.1
Sauce	2.2	3.3	55.3	60.8
Shortcake	3.8	14.1	34.2	52.1
Stewed	2.1	1.0	39.7	42.8
Toast	4.7	.3	34.4	39.4
Armenian Scalloped Eggplant	3.3	14.0	17.9	35.2
Artichokes, Buttered	2.7	31.4	16.7	50.8
Creamed	3.4	8.8	15.8	28.0
Scalloped	4.0	12.5	16.8	33.3
Asparagus, Boiled	1.9	24.5	3.3	29.7
Broth	1.2	7.5	1.2	9.9
In Cream	2.4	16.2	4.2	22.8
In Croustads	4.8	16.9	24.9	46.6
With Green Peas	2.2	10.0	7.8	20.0
Loaf	4.2	20.8	8.3	33.3
Luncheon Salad	2.2	59.6	3.4	65.2
Souffle	5.9	20.1	4.1	30.1
Soup, Cream of	3.3	16.1	5.4	24.8
Tips on Toast	3.8	59.7	17.1	80.6
Avocado or alligator pear	2.5	44.1	5.0	51.6
Banana	1.5	1.5	24.9	27.9
Baked	3.8	4.5	32.8	41.1
Sliced With Cherry Sauce	1.4	1.3	24.7	27.4
Purée	1.5	1.5	24.9	27.9
Dessert	1.7	9.2	22.6	33.5
Fritters	5.3	37.8	40.7	83.8

	Protein	Fats	Carbo.	Total
Ice Cream	3.2	16.7	15.7	35.6
with Mayonnaise	1.9	7.8	21.9	31.6
Mold	.4	.5	33.7	34.6
Mousse	2.3	16.4	31.3	50.0
Shortcake	3.4	6.6	31.1	41.1
Snow	1.7	.6	50.6	52.9
Strawberry Jelly	1.6	.5	20.8	22.9
Toast	3.5	2.1	35.1	40.7
and Walnut Salad	2.6	13.1	24.2	39.9
Barley Gruel	1.1	.5	7.8	9.4
Pearled	2.2	.6	19.9	22.7
with Dates	1.6	1.2	23.0	25.8
Soup	.9	5.6	5.1	11.6
Soup, Cream of	1.8	11.0	4.1	16.9
Water	.2	.1	1.4	1.7
Beans Baked	6.7	9.9	21.5	38.1
Broth	9.8	11.4	29.3	50.5
Butter	9.6	25.4	29.3	64.3
Green Lima	7.4	6.1	22.9	36.4
Salad	2.1	6.5	6.9	15.5
(Baked) Sandwich	6.8	51.9	35.0	93.7
Soup	6.5	4.6	17.3	28.4
Soup, Cream of	1.9	5.6	4.4	11.9
Tapioca Soup	3.7	7.2	14.2	25.1
String	3.4	14.5	8.1	26.0
Beaten Biscuit	10.8	47.6	69.7	128.1
Bechamel Sauce	3.7	27.3	9.1	40.1
Beechnut E. P.	24.8	146.4	15.3	186.5
Beets, Buttered	1.7	6.8	10.7	19.3
Greens	2.3	31.7	3.2	37.2
Italian	1.8	14.6	6.4	22.8
and Peas in Aspic	2.3	6.7	7.6	16.6
and Potato Salad	2.7	2.5	13.9	19.1
Salad	2.8	4.2	8.4	15.4
Soup, Russian	.7	6.7	3.9	11.3
Berkeley Salad	.6	1.1	29.6	31.3
Biscuit, Beaten	10.8	47.6	69.7	128.1
Bran	17.8	9.0	49.5	76.3
Cream	9.9	23.2	58.7	91.8
Fruit	8.1	19.3	62.4	89.8
Graham and Bran	12.8	23.7	47.3	83.8

	Protein	Fats	Carbo.	Total
Blackberries	1.5	2.6	12.4	16.5
Gelee	.9	1.6	17.2	19.7
Juice	....	....	30.3	30.3
Pie	3.0	22.6	37.2	62.8
Sauce	.9	5.4	64.0	70.3
Toast	3.7	2.9	38.5	45.1
Blueberries	.7	1.5	18.8	21.0
Canned	.7	1.5	14.5	16.7
Gems	7.3	16.6	44.8	68.7
Juice	....	....	18.9	18.9
Muffins	8.5	19.3	52.5	80.3
Pie	3.1	26.8	51.8	81.7
Sauce	.7	1.5	14.5	16.7
Toast	3.6	1.5	30.7	35.8
Bouillon, Golden	.6	1.9	.7	3.2
Nut	1.0	2.5	2.2	5.7
Savora	.6	.1	.4	1.1
Tomato	1.2	.5	5.3	7.0
Vegetable	2.4	.4	11.4	14.2
Boston Brown Bread	6.7	7.0	50.5	64.2
Bran, Sterilized	22.9	11.6	17.8	52.3
Biscuit	17.8	9.0	49.5	76.3
Gems	13.5	39.1	42.7	95.3
and Graham Biscuit	12.8	23.7	47.3	83.8
and Granola Mush	4.7	3.1	17.3	25.1
Mush	3.6	1.8	8.3	13.7
Porridge	3.1	2.0	30.9	36.0
Porridge with Apple Sauce	4.0	4.1	26.6	34.7
Brazil Nuts	19.3	170.3	7.9	197.5
Bread, Boston Brown	6.7	7.0	50.5	64.2
Corn	8.9	8.3	62.5	79.7
Custard	5.3	10.9	21.2	37.4
Fruit	8.7	11.1	71.9	91.7
Gluten	28.1	11.7	31.7	71.5
Gluten Bran	21.1	40.5	25.0	86.7
Graham	12.3	8.1	55.8	76.2
Soft Graham	9.0	7.0	56.9	72.9
Milk	11.1	10.8	66.9	88.8
Nut	11.9	28.7	64.8	105.4

	Protein	Fats	Carbo.	Total
Pudding, Steamed	4.3	15.6	36.5	56.4
Salt-rising	10.3	11.1	64.0	85.4
Vita	17.0	4.5	85.5	107.0
Wheat	10.4	3.3	59.6	73.3
White	10.0	6.1	58.7	74.8
Wholewheat	10.9	6.8	57.5	75.2
Breakfast Toast	15.2	1.1	76.2	92.5
Bromose, Fig	15.3	51.3	63.1	129.7
Nut	22.3	72.8	48.6	143.7
Brose, Wheat	1.0	.3	5.6	6.9
Brose, Scotch	3.1	3.1	12.5	18.7
Scotch Bran	3.9	3.1	14.6	21.6
Broth, Asparagus	1.2	7.5	1.2	9.9
Bean	9.8	11.4	29.3	50.5
Mock Chicken	8.1	7.0	4.4	21.5
Mushroom	1.7	12.2	4.8	18.7
Protose	8.7	8.0	4.9	21.6
Savory Potato	1.2	5.8	4.7	11.7
Brown Cream Gravy	6.3	32.4	9.8	47.5
Sauce	1.0	21.9	5.1	28.0
Sugar Sauce	.1	13.5	71.1	84.7
Betty	1.7	9.4	36.9	48.0
Brussels Sprouts,				
Buttered	1.6	31.2	3.3	36.1
Creamed	2.8	12.2	7.6	22.6
Bulgarian Salad	12.9	91.0	8.2	112.1
Buns, Cinnamon	6.7	24.6	56.8	88.1
Fruit	8.1	13.9	58.9	80.9
Nut	13.4	40.2	58.4	112.0
Burnt Leather Cake	3.4	23.9	72.9	100.2
Butter	1.1	216.8	....	217.9
Sauce, Drawn	4.9	51.9	3.3	60.1
Buttermilk	4.3	3.1	3.7	11.1
Buttermilk, Yogurt	4.0	.8	6.0	10.8
Butternuts	31.6	156.1	4.0	191.7
Cabbage	1.8	.8	6.4	9.0
Baked	3.9	7.5	5.7	17.1
Baked in Tomato	1.7	3.5	5.5	10.7
Creamed	3.0	17.9	8.2	29.1
Salad	2.1	18.4	8.5	29.0
Scalloped	2.5	9.7	10.1	22.3

	Protein	Fats	Carbo.	Total
Stewed	1.8	13.5	5.9	21.2
Cabinet Pudding	6.0	32.1	63.3	101.4
Cakes, Apple Sauce	3.2	23.9	61.8	88.9
Burnt Leather	3.4	23.9	72.9	100.2
Cinnamon	6.5	24.2	66.6	97.3
Cream	6.8	18.2	72.1	97.1
Coffee	6.1	34.9	64.8	105.8
Corn	8.9	14.7	52.7	76.3
Cup or Imperial ..	6.8	2.2	77.3	86.3
Economy	5.4	22.3	70.4	98.1
Fruit	6.0	37.6	66.5	110.1
Fruit Drop	7.6	59.8	62.6	130.0
German Potato ...	12.6	25.6	100.1	138.3
Gold	6.6	40.5	45.1	92.2
Lady Baltimore ..	3.7	22.0	73.5	99.2
Lady Fingers....	4.7	7.0	86.7	98.4
Mock Angel Food..	5.1	4.6	64.7	74.4
Nut	7.6	37.4	61.3	106.3
Nut Sponge	10.4	27.7	70.9	109.0
Oaten	13.6	37.1	66.7	117.4
Oatmeal Hermits ..	9.0	55.8	73.3	139.1
One Egg	6.5	29.5	67.5	103.5
Orange	3.4	14.9	45.6	63.9
Orange Sponge ...	6.3	5.9	74.8	87.0
Plain	6.4	25.9	65.5	97.8
Roxbury	8.8	42.3	63.8	114.9
Small Fancy	4.1	1.4	82.4	87.9
Sponge	8.9	10.7	77.9	97.3
Sunshine	12.1	18.8	51.1	82.0
White Layer	5.8	33.9	57.9	97.6
White Sponge	10.6	.9	60.1	71.6
California Raisin Salad ..	1.7	3.6	37.7	43.0
Cantaloup	.7	....	10.5	11.2
Caramel Custard	5.2	12.2	15.9	33.3
Custard, Baked ..	4.6	10.7	24.3	39.6
Carrots, Buttered	1.2	44.2	8.4	53.8
Creamed	2.5	12.7	11.6	26.8
Mashed	1.2	6.1	10.3	17.6
with Peas	3.7	9.8	11.4	24.9
Souffle	5.6	20.7	10.2	36.5
Cauliflower, Buttered ...	1.9	15.6	4.9	22.4

	Protein	Fats
Creamed	2.1	9.1
Au Gratin	2.6	9.2
Salad	2.5	8.9
Souffle	8.0	29.7
and Tomato Salad	1.6	19.5
Celery	1.2	.3
and Apple Salad	1.4	1.9
Creamed	2.1	10.2
Grapefruit Salad	1.6	7.0
and Peas	2.0	6.2
and Peas Salad	3.2	9.9
and Pineapple Sandwich	4.4	46.9
and Potato Hash	2.4	7.0
and Potato Salad	3.5	8.8
Relish	1.7	1.0
Salad	2.3	12.8
Sandwiches	5.3	56.7
Scalloped	2.9	25.3
Sauce	2.6	13.1
Souffle	6.9	25.2
Soup, Cream of	2.0	15.0
Steamed	1.2	10.1
and Tomato Salad	1.4	4.4
and Tomato Soup	2.1	5.6
Toast	4.8	7.7
and Vegetable Oyster Soup	1.2	14.8
Cereal Roast	16.0	27.4
Charlotte Russe	2.5	41.9
Cheese, Apple and Nut Salad	6.7	77.4
Balls	19.1	99.9
Cottage	23.7	2.6
Sandwich, Cottage	10.7	61.4
Fruit Salad	9.9	96.2
and Marmalade Sandwich	7.1	45.3
and Pineapple Sandwiches	7.7	64.7
Rarebit, Yogurt	10.6	46.2

	Protein	Fats	Carbo.	Total
and Rice	6.7	20.5	23.4	50.6
(Yogurt) Salad	17.3	80.5	5.0	102.8
Sauce	5.5	28.2	7.3	41.0
Straws	10.6	75.2	49.2	135.0
and Tomato Salad	9.1	7.3	5.3	21.7
and Tomato Sandwich	9.3	3.7	63.4	76.4
Yogurt	20.3	82.8	3.9	107.0
Cherries E. P.	1.1	2.0	18.9	22.0
A. P.	1.0	2.0	18.0	21.0
Canned with Stones	.7	1.3	41.5	43.5
Canned without Stones	.6	1.2	43.2	45.0
Gelee	.7	1.2	21.3	23.2
Pie	2.8	17.8	41.2	61.8
Toast	4.0	1.8	38.8	44.6
Chestnuts, Fresh E. P.	7.0	13.8	47.7	68.5
A. P.	5.9	11.5	40.1	59.5
Creamed	9.9	22.4	63.9	96.2
Dried E. P.	12.1	17.9	84.1	114.1
Pie	7.5	25.1	42.4	75.0
Roast	9.4	20.0	45.1	74.5
Soup, Cream of	4.5	17.9	14.7	37.1
with Tomato Sauce	5.9	21.5	62.4	89.8
Chicken Broth, Mock	8.1	9.0	4.4	21.5
Soup, Mock	.9	13.1	5.8	19.8
Chili Sandwich	11.1	24.5	45.0	80.6
Sauce	4.2	1.5	33.4	39.1
Chocolate Blanc Mange	3.4	8.5	25.1	37.0
Chocolates, Health	1.0	3.8	85.2	90.0
Chocolate Ice Cream	5.1	50.9	166.0	222.0
Icing	3.3	23.9	80.3	107.5
Pie	4.2	16.8	24.1	45.1
Sauce	7.6	116.3	470.8	594.7
Chowder, Corn	3.1	14.8	16.1	34.0
Potato	2.5	9.8	9.3	21.6
Washington	2.3	8.8	11.3	22.4
Cinnamon Cake	6.5	24.2	66.6	97.3
Buns	6.7	24.6	56.8	88.1

	Protein	Fats	Carbo.	Total
Cocktail, Fruit	1.9	7.6	23.1	31.6
Grapefruit	.6	.3	20.6	21.5
Cocoa, Sanitas	2.1	13.6	3.3	19.0
Cocoanut E. P.	6.5	129.0	31.6	167.1
(Prepared)	7.1	146.4	35.7	189.2
Blanc Mange	3.7	22.8	27.1	53.6
Cream Pie	7.3	43.6	34.3	85.2
Custard	5.9	26.8	13.8	46.5
Dates	6.0	55.3	65.0	126.3
Milk	.5	3.8	5.2	9.5
Coffee Cake	6.1	34.9	64.8	105.8
Cold Slaw	2.9	8.4	8.6	19.9
Combination Green Salad	.9	9.4	4.2	14.5
Compote of Fruit with Rice	1.7	.4	34.4	36.5
Cookies	7.0	34.9	77.7	119.6
Cream	8.0	41.5	72.2	121.7
Molasses	7.8	3.4	83.6	94.8
Corn Bread	8.9	8.3	62.5	79.7
Cake	8.9	14.7	52.7	76.3
Chowder	3.1	14.8	16.1	34.0
Creamed	3.5	8.9	17.7	30.1
Creamed Au Gratin	4.4	20.3	14.6	39.3
Flakes	.8	.1	7.0	7.9
Hulled	2.6	2.3	25.2	30.1
with Macaroni	3.7	5.8	16.7	26.2
Parched	13.0	21.4	82.0	116.4
Pones	5.4	16.9	48.5	70.8
Pudding	4.9	13.7	12.9	31.5
Pulp	3.4	26.7	20.6	50.7
Roast	8.5	9.5	34.5	52.5
Scalloped	4.2	5.8	30.9	40.9
Soup Cream of ...	3.6	13.2	12.5	29.3
and Tomato Stew .	2.3	1.8	13.0	17.1
Cornmeal Cutlets	3.7	3.5	17.1	24.3
Granulated	10.4	4.8	84.4	99.6
Gruel	.4	.6	3.9	4.9
Mush	1.4	1.8	12.5	15.7
Cornstarch Pudding	4.1	10.2	18.8	33.1
Pudding, Caramel .	2.4	6.5	30.2	39.1

	Protein	Fats	Carbo.	Total
Cottage Cheese	23.7	2.6	4.9	31.2
Cheese Sandwich	10.7	61.4	27.9	100.0
Pudding	6.4	23.3	61.6	91.3
Salad	8.9	7.1	10.9	26.9
Crab Apple, Canned	.2	.7	36.9	37.8
Cranberry Sauce with				
Nuttolene	11.0	43.1	20.5	74.6
Sherbet	.2	.4	35.6	36.2
Cream	2.8	47.2	5.1	55.1
Crisps	12.8	27.9	81.9	122.6
Mocked Whipped	5.8	9.2	18.5	33.5
Puffs	6.6	31.1	31.4	69.1
Salad Dressing	3.4	46.2	13.5	63.1
Sauce	4.2	22.7	10.8	37.7
Sticks	9.4	22.7	85.6	117.7
of Wheat	1.5	.4	10.4	12.3
Whipped	2.6	44.4	9.9	56.9
Yogurt Buttermilk	3.6	16.3	5.7	25.6
Crecy Soup, Cream of	2.7	11.9	6.5	21.1
Creole Sauce	1.9	24.8	9.3	36.0
Soup	1.6	3.9	8.3	13.8
Croquettes, Lima Bean	20.0	14.5	66.9	101.4
Nut and Rice	10.8	7.8	14.7	33.3
Nuttolene	13.4	52.9	14.8	81.1
Pinenut	25.5	71.2	13.7	110.4
Potato	5.4	19.9	21.2	46.5
Potato and Protose	7.7	9.0	14.7	31.4
Potato and Rice	3.1	4.3	20.2	27.6
Protose	24.6	24.4	16.2	65.2
Walnut	17.5	88.4	39.4	145.3
Cucumber E. P.	.9	.5	3.5	4.9
Jelly	.4	.3	2.9	3.6
Sandwich	4.7	49.0	27.8	81.5
and String Bean Salad	1.0	21.1	22.4	44.5
Stuffed	1.9	5.6	13.2	20.7
and Tomato Salad	.9	6.2	3.7	10.8
Cup Custard	5.2	12.2	15.9	33.3
or Imperial Cakes	6.8	2.2	77.3	86.3
Currants, Fresh E. P.	1.7	....	14.5	16.2

	Protein	Fats
Currant Gems	7.3	17.1
Zante A. P.	2.7	4.3
Custard, Bread	5.3	10.9
Caramel	5.2	12.2
Caramel, Baked	4.6	10.7
Cocoanut	6.0	55.3
Cup	5.2	12.2
Maple	4.9	16.5
Peach	3.9	8.6
Pie	6.1	25.1
Plain	4.3	10.7
Sauce	4.1	10.2
Cutlets, Cornmeal	3.7	3.5
Dandelion Greens	2.5	26.4
Dasheens Sliced in Cream	6.0	7.6
Scalloped	6.3	10.3
Soup, Cream of	4.9	11.1
Dates, Dried E. P.	2.4	7.1
Dried A. P.	2.2	6.4
Date and Apple Fluff	1.7	2.9
and Apple Salad	1.9	11.4
Cocoanut	6.0	55.3
Cream Pie	5.0	19.3
Gems	11.8	19.4
Muffins	7.5	27.2
Pudding	6.9	19.6
Sandwich	6.5	21.2
Surprise	3.3	11.9
Toast	4.0	4.8
and Walnut Salad	8.7	58.9
Dressing, Berkeley Salad	....	....
Boiled	4.2	35.8
Cream Salad	3.4	46.2
French Salad	....	198.1
Golden Salad	2.8	5.0
Mayonnaise, Raw	2.6	186.2
Mayonnaise, Cream	5.4	63.9
Meltose	1.0	1.8
for Roasts	4.9	11.6

	Protein	Fats	Carbo.	Total
Sanitarium Salad	.2	96.1	8.6	104.9
Economy Fruit Cake	5.4	22.3	70.4	98.1
Eggs, Alpine	16.5	40.8	1.0	58.3
Boiled	15.0	30.6	....	45.6
Baked in Cream ..	12.3	35.8	1.7	49.8
Cream Baked	7.9	24.8	5.5	38.3
in Croustads with Celery Sauce	9.8	14.7	25.4	49.9
Poached with Cornflakes	14.1	41.4	....	55.5
A La Goldenrod .	8.4	27.4	5.6	41.4
Macaroni	4.9	6.9	19.5	31.3
and Macaroni	6.5	16.8	20.5	43.8
Nog Foamy	9.7	25.5	8.6	43.8
Fruit	12.4	15.4	22.7	50.5
Lemon	10.2	.4	17.8	28.4
Malted Nuts	10.2	24.2	13.3	47.7
Milk	5.6	12.7	9.0	27.3
and Olive Sandwich	6.0	62.0	27.0	95.0
Omelet	10.2	29.9	....	40.1
and Onion in White Sauce	4.2	11.9	8.1	24.2
Baked in Tomato..	9.2	15.3	1.9	26.4
Sandwich	9.1	56.5	27.3	92.9
Sauce	5.2	22.4	6.8	34.4
Scalloped	8.3	27.3	13.5	49.1
Scrambled	13.3	24.4	1.4	39.1
Scrambled on Toast	9.8	20.3	17.9	48.0
Spanish	8.9	36.7	17.9	63.5
Timbales	8.2	16.8	3.8	28.8
Yolks	18.3	80.0	....	98.3
Egg Plant, Armenian				
Scalloped	3.3	14.0	17.9	35.2
Baked	3.4	10.3	12.2	25.9
Creamed	2.1	9.6	6.9	18.6
Stuffed	2.9	6.7	10.2	19.8
Souffle	6.2	22.7	7.8	36.7
Farina	1.2	1.8	5.5	8.5
Blanc Mange	3.6	9.3	8.4	21.3

	Protein	Fats
Gruel	1.0	.3
Fig Bromose	15.3	51.3
Dried	4.9	.8
Fresh	1.7	....
Nut Sandwiches	9.3	33.1
Pudding	4.9	9.2
Steamed	4.9	.8
Stuffed	10.2	55.2
Tapioca Pudding	2.3	.4
Filberts	17.7	166.5
Cherry Salad	4.3	36.5
Fillet of Nutmeat	12.2	17.7
Filling, Fruit	5.8	40.2
Lemon	2.9	33.7
Orange	3.5	18.7
Floating Island	4.4	10.9
Fonchonettes	4.5	2.1
French Apple Toast	6.2	9.5
Floating Island	3.9	13.7
Salad	2.6	8.7
Salad Dressing	....	198.1
Frosting, Boiled	.9	....
Orange	.4	1.0
Ornamental	2.9	.1
Water	.4	1.0
Fruit Beverage	....	....
Bread	8.7	11.1
Biscuits	8.1	19.3
Buns	8.1	13.9
Cake	6.0	37.6
Cheese Salad	9.9	96.2
Crackers	6.4	18.4
Cocktail	.9	7.6
Drop Cakes	7.6	59.8
Egg Nog	12.4	15.4
Filling	5.8	40.2
Jellied	1.2	5.3
Jelly	....	....
Macedoine Salad, No. 1	.9	1.0

	Protein	Fats	Carbo.	Total
Macedoine Salad, No. 2	.8	.5	22.0	23.3
Punch	.1	.3	28.4	28.8
Pudding, Steamed	3.2	20.1	46.9	70.2
Salad	1.5	2.4	26.1	30.0
Salad a la Cream	1.4	8.5	28.1	38.0
Sandwich and Whipped Cream	3.5	8.3	25.7	37.5
Souffle	2.4	3.9	48.5	54.8
Soup	.5	.7	31.4	32.6
Gelée, Apricot	.8	....	16.2	17.0
Blackberry	.9	1.6	17.2	19.7
Blueberry	....	....	18.5	18.5
Grape	....	....	21.5	21.5
Lemon	.5	....	20.3	20.8
Peach	....	....	19.7	19.7
Pear	....	....	17.0	17.0
Pineapple	....	....	14.5	14.5
Plum	.7	....	20.9	21.6
Prune	.4	.2	22.4	23.0
Orange	....	....	15.2	15.2
Raspberry	.7	....	15.6	15.3
Strawberry	.6	....	41.9	42.5
Gems, Blueberry	7.3	16.6	44.8	68.7
Bran	12.8	35.3	41.2	89.3
Currant	17.3	17.1	48.4	72.8
Date	11.8	19.4	68.9	98.6
Graham	9.8	15.1	44.9	69.8
Good Health	8.5	29.8	36.9	75.2
Nut	7.9	36.3	36.1	80.3
Raisin	7.4	17.8	43.0	68.2
White	5.8	48.9	11.5	66.2
Wholewheat	9.3	14.4	45.9	69.6
Gluten Biscuit, Pure	90.2	2.6	12.5	105.3
Biscuit, 40%	47.5	3.3	54.4	104.9
Gluten Bread	28.1	11.7	31.7	71.5
Bran Bread	21.2	40.5	25.0	86.7
Gruel	3.7	.6	4.2	8.5
Gruel, Cream of	6.9	18.6	9.3	34.8
Mush	2.3	.7	11.7	14.7
Mush, Creamed	5.2	17.8	14.6	37.6
Puffs	23.1	42.9	24.5	90.5

	Protein	Fats	Carbo.	Total
Gold Cake	6.6	40.5	45.1	92.2
Golden Bouillon	.6	1.9	.7	3.2
Nectar	....	....	21.4	21.4
Salad Dressing	2.8	5.0	44.4	52.2
Sauce	1.8	60.5	50.5	122.8
Good Health Breakfast Food	11.3	4.3	71.9	87.5
Gems	8.5	29.8	36.9	75.2
Graham Bread	11.6	8.0	51.0	70.6
Soft	9.0	7.0	56.9	72.9
and Bran Biscuit	12.8	23.7	47.3	83.8
Gems	9.8	15.1	44.9	69.8
Mush with Dates	2.3	2.0	26.8	31.1
Pudding	6.2	6.2	57.1	69.5
Granola and Bran Mush	3.4	.9	16.0	20.3
Date Mush	4.4	1.1	33.4	38.9
Fruit Mush	5.2	.7	36.3	42.2
Fruit Pudding	4.9	9.2	59.0	73.1
Gruel	1.7	.1	9.4	11.2
Mush	4.7	.3	30.9	35.9
Granose Biscuit	9.8	4.8	92.6	107.2
Flakes	10.4	4.3	87.1	101.8
Granuto	9.2	15.3	90.9	115.4
Granose Flakes Gruel	.8	.3	6.9	8.0
Grapes, Fresh A. P.	1.1	3.1	16.3	20.5
Gelee	....	....	21.5	21.5
Juice	....	....	23.8	23.8
Salad	3.6	31.8	6.8	42.2
Sherbet	.8	13.9	24.4	39.1
Toast	2.9	1.2	39.6	43.7
Grapefruit	.9	.5	11.8	13.2
and Celery Salad	1.6	7.0	8.7	17.3
Cocktail	.6	.3	20.6	21.5
Gravy, Brown Cream	6.3	32.4	9.8	47.5
Protose	5.4	9.2	3.6	18.2
Spanish	1.5	14.0	4.7	20.2
Greens, Beet	2.3	31.7	3.2	37.2
Dandelion	2.5	26.4	10.7	39.6
Griddle Cakes, Rice	8.7	4.5	48.1	61.3
Cakes, Wheat	8.7	11.0	32.2	50.9
Gruel, Barley	1.1	.5	7.8	9.4

	Protein	Fats	Carbo.	Total
Cornflakes	.8	.1	7.0	7.9
Farina	1.0	.3	6.6	7.9
Cornmeal	.4	.6	3.9	4.9
Gluten	3.7	.6	4.2	8.5
Gluten, Cream of .	6.9	18.6	9.3	34.8
Granola	1.7	.1	9.4	11.2
Granose Flakes ..	.8	.3	6.9	8.0
Hominy Grits	.3	.6	2.5	3.4
Oatmeal	.8	.8	3.1	4.7
Baked Potato	.6	.1	5.2	5.9
Cream Baked Potato	3.4	17.0	7.5	27.9
Rice Flakes	1.1	.4	5.7	7.2
Rice Meal	.9	1.5	7.3	9.7
Wheat Flakes	.7	.3	6.6	7.6
Ham, Vegetarian	20.0	61.1	6.8	87.9
Hard Sauce	.5	86.8	68.1	155.4
Hazelnuts E. P.	9.1	72.7	13.0	94.8
Health Chocolates	1.0	3.8	85.2	90.0
Hickory Nuts E. P.	17.5	171.9	12.9	202.3
Nuts A. P.	6.6	65.0	4.9	76.5
Hoe Cake	4.5	1.5	45.4	51.4
Sanitarium	6.6	22.0	48.4	77.0
Hollandaise Sauce	4.0	123.4	....	127.4
Hominy, Boiled	9.4	1.5	89.6	100.5
Creamed	2.6	5.5	18.8	26.9
Croquettes	3.8	5.9	18.8	28.5
Grits	1.8	.5	14.8	17.1
Grits Gruel	.3	.6	2.5	3.4
Honey, White Clover	.5	....	92.1	92.6
Huckleberries E. P.	.7	1.5	18.8	21.0
Ice, Almond	4.4	23.5	3.3	31.2
Orange Water	....	....	30.4	30.4
Ice Cream, Almond	3.5	29.3	9.7	42.5
Baked Apple	1.8	28.8	15.7	46.3
Banana	3.2	16.7	15.7	35.6
Chocolate	5.1	50.9	166.0	222.0
Maple	1.9	32.8	35.5	70.2
New York	3.7	26.9	25.1	55.7
Nougat	4.2	46.5	20.7	71.4
Orange	1.3	22.2	16.2	39.7
Peach	3.2	16.8	9.6	29.6

	Protein	Fats	Carbs.	Total
Pineapple	3.1	17.2	16.7	37.0
Strawberry	4.3	22.5	13.3	40.1
Vanilla	3.8	18.3	13.7	35.8
Yogurt	2.0	18.1	24.4	44.5
Icing, Chocolate	3.3	23.9	80.3	107.5
Imperial or Cup Cake ...	6.8	2.2	77.3	86.3
Indian Pudding	6.2	12.2	31.2	49.6
Pudding, Baked ..	5.4	13.3	18.0	36.7
Triffle	3.3	9.0	29.8	42.1
Italian Soup	1.1	.6	5.1	6.8
Jam, Red Raspberry	.9	....	102.2	103.1
Japanese Crosnes, Creamed	1.7	11.5	4.6	17.8
Jelly, Apple	....	....	64.5	64.5
Cucumber	.4	.3	2.9	3.6
Fruit	....	....	50.4	50.4
Lemon	....	....	37.6	37.6
Mint	....	....	22.5	22.5
and Nuttolene	10.5	20.1	23.5	54.1
Orange	....	....	45.4	45.4
Pineapple	....	....	44.9	44.9
Quince	....	....	73.7	73.7
Roll	6.2	12.2	72.9	91.3
Sandwiches, Apple	5.9	35.6	53.9	95.4
Banana and Strawberry	1.6	.5	20.8	22.9
Tomato	1.1	.4	7.1	8.6
Yogurt	2.2	7.3	5.1	14.6
and Yogurt Sandwiches	7.1	57.5	40.3	104.9
Johnny Cake	8.8	5.6	65.2	79.6
Sanitarium	6.3	23.5	46.1	75.9
Kidney Beans, Macaroni	6.3	6.8	22.4	35.5
Lady Baltimore Cake	3.7	22.0	73.5	99.2
Fingers	4.7	7.0	86.7	98.4
Lemons E. P.	1.1	1.8	9.6	12.5
A. P.	.8	1.3	6.7	8.8
Juice	....	....	11.1	11.1
Apple	.5	4.6	26.7	31.8
Cream	4.3	10.7	22.7	37.7
Cream Sauce	3.7	49.5	40.9	94.1

	Protein	Fats	Carbo.	Total
Egg Nog	10.2	.4	17.8	28.4
Dressing	....	12.4	59.5	71.9
Filling	2.9	33.7	63.0	99.6
Gelee	.5	....	20.3	20.8
Jelly	....	....	37.6	37.6
Juice	....	....	11.1	11.1
Pie	2.2	27.3	21.3	50.8
Sauce	.9	18.2	82.8	101.9
Sherbet	.9	....	26.6	27.5
Lentils, Baked	9.1	8.0	20.9	38.0
and Potato Loaf	5.9	9.3	19.3	34.5
Soup	1.0	3.4	8.9	13.3
Soup, Cream of	9.3	21.7	20.3	51.3
Lettuce	1.4	.8	3.3	5.5
and Mayonnaise	1.7	37.8	2.9	42.4
Sandwich	5.5	59.1	32.9	97.5
Soup, Cream of	2.6	13.8	4.6	21.0
Litchi Nuts E. P.	3.3	.5	87.9	91.7
Lima Beans, Baked	20.8	25.9	69.3	116.0
Croquettes	20.0	14.5	66.9	101.4
Green	7.4	6.1	22.9	36.4
Bean Loaf	13.1	26.7	40.8	80.6
Soup	2.1	3.8	8.0	13.9
Soup, Cream of	3.9	8.9	10.5	23.3
(Green) Toast	5.9	6.3	25.1	37.3
Log Cabin Pudding	5.1	11.7	51.9	68.7
Lyonnaise Potatoes	2.4	14.7	19.5	36.6
Macaroni	14.1	19.7	81.4	115.2
with Corn	3.7	5.8	16.7	26.2
Creamed	5.3	13.1	23.4	41.8
with Eggs	6.5	16.8	20.5	43.8
Egg	4.9	6.9	19.5	31.3
Au Gratin	5.9	18.2	16.5	40.6
and Green Peas	3.9	11.6	15.0	30.5
and Kidney Beans	6.3	6.8	22.4	35.5
with Tomato	3.1	8.0	15.9	27.0
and Tomato Soup	2.1	7.6	9.0	18.7
Macedoine Salad	1.3	32.9	11.4	45.6
Malted Milk, Cold	5.9	4.3	39.4	49.6
Hot	2.5	2.9	9.9	15.3
Malted Nuts (Dry)	26.9	70.6	49.8	147.3

	Protein	Fats
Hot	4.8	12.6
Egg Nog	10.2	24.2
Frozen	9.3	23.3
Manhattan Soup	2.9	17.4
Maple Apple	.4	1.1
Custard	4.9	16.5
Ice Cream	1.9	32.8
Marguerites	1.9	7.5
Mousse	2.9	30.7
Sauce	.1	11.4
Sugar	....	....
Syrup	....	....
Marmalade and Cheese Sandwich	7.1	45.3
Marshmallow Filling	.4	....
Mayonnaise Dressing, Raw	2.6	186.2
Cream	5.4	63.9
Meltose (Malt Honey)	....	....
Sugar	2.0	.3
Dressing	2.7	1.8
Mousse	3.5	30.7
Meringue for Prune Souffle	10.8	60.2
Milk	3.7	10.2
and Cream	3.4	22.5
Bread	11.1	10.8
Cocoanut	.5	3.8
Egg Nog	5.6	12.7
Sherbet	2.3	6.3
Skimmed	3.9	.8
Mince Pie, Sanitarium	4.9	27.6
Minute Brew, Prepared	.8	13.3
Mint Jelly	....	....
Julep	....	....
Sauce	....	....
Sherbet	.6	....
Mock Angel Food Cake	5.1	4.6
Molasses	2.7	....
Molasses Cookies	7.8	3.4
Mousse, Banana	2.3	16.4
Maple	2.9	30.7

	Protein	Fats	Carbo.	Total
Meltose	3.9	30.7	23.9	58.1
Muffins, Blueberry	8.5	19.3	52.5	80.3
Date	7.5	27.2	67.1	101.8
Rice	7.9	24.0	44.3	76.2
Mulberries	.3	....	16.3	16.6
Mush, Bran	2.2	1.2	7.4	10.8
Bran and Granola	4.7	3.1	17.3	25.1
Cornmeal	1.7	.8	14.3	16.8
Gluten	2.3	.7	11.7	14.7
Creamed Gluten	5.2	17.8	14.6	37.6
Graham with Dates	2.3	2.0	26.8	31.1
Granola	4.7	.3	30.9	35.9
Granola Date	4.4	1.1	33.4	38.9
Granola Fruit	5.2	.7	36.3	42.2
Mushroom Broth	1.7	12.2	4.8	18.7
Buttered	3.7	17.6	7.1	28.4
Creamed	4.1	12.7	9.9	26.7
Oatmeal Soup No. 1	2.0	9.5	5.0	16.5
Sauce	1.7	26.9	5.9	34.5
Muskmelon E. P.	.7	....	10.5	11.2
A. P.	.3	....	5.2	5.5
Nectar, Golden	....	....	21.4	21.4
Raspberry	....	....	16.9	16.9
Nectarines E. P.	.7	....	18.0	18.7
A. P.	.7	....	16.8	17.5
Neopolitan Toast	5.2	12.4	20.3	37.9
New York Ice Cream	3.7	26.9	25.1	55.7
Noodles	11.6	15.0	56.7	83.3
Soup	3.8	11.9	15.3	31.0
Normandy Loaf	14.6	30.6	19.0	64.2
Nougat Ice Cream	4.2	46.5	20.7	71.4
Nut and Apple Pie	8.7	16.0	28.0	52.7
Apple and Cheese Salad	6.7	77.4	8.5	92.6
Bouillon	1.0	2.5	2.2	5.7
Bread	11.9	28.7	64.8	105.4
Bromose	22.2	72.9	48.5	143.6
Buns	13.4	40.2	58.4	112.0
Butter	33.2	118.6	19.4	171.2

	Protein	Fats
Cake	7.6	37.4
Chops	8.0	29.8
or Protose Cutlets	14.7	17.7
Fig Sandwiches	9.3	33.1
Fillet	11.7	29.3
French Soup	.9	1.9
Gems	7.9	36.3
Loaf with Peas	17.9	34.6
Meat Fillet	12.2	17.7
Meat Loaf	20.9	42.2
Meat Pie	11.6	25.6
Patties	22.4	47.4
or Protose Cutlets	14.7	17.7
and Rice Croquettes	11.8	10.9
Rice Soup	1.5	4.6
Sausage	20.1	55.6
Olive Sandwich	7.3	80.2
Sponge Cake	10.4	27.7
and Vegetable Stew	11.4	17.7
Nut Meal	38.0	120.0
Nuts, Almonds E. P.	23.8	139.9
Beechnut E. P.	24.8	146.4
Butternuts E. P.	31.6	156.1
Brazil E. P.	19.3	170.3
Cashew E. P.	11.0	120.1
Chestnuts (Dried) E. P.	12.1	17.9
Chestnuts, Fresh E. P.	7.0	13.8
Chinquapin E. P.	12.4	1.8
Cocoanut E. P.	6.5	129.0
Cocoanut Prepared E. P.	7.1	146.4
Filberts E. P.	17.7	166.5
Hazelnut E. P.	9.1	72.7
Hickory E. P.	17.5	171.9
Litchi E. P.	3.3	.5
Paradise E. P.	25.2	159.6
Peanuts E. P.	29.3	98.4

	Protein	Fats	Carbo.	Total
Pecans E. P.	10.9	179.8	17.4	208.1
Pine,				
Pignolias E. P.	38.4	126.0	7.8	172.2
Pinon E. P.	16.6	157.9	19.6	194.1
Pistachios E. P.	25.3	137.7	18.5	181.5
Walnuts E. P.	20.9	164.2	14.7	199.8
Walnuts,				NN
Black E. P.	31.3	143.6	13.3	188.2
Walnuts,				
English E. P.	20.9	164.2	14.7	199.8
Nuttolene and Apple				
Sauce	11.0	43.2	13.6	67.8
Baked	13.7	53.6	7.3	74.6
and Bechamel				
Sauce	12.2	52.0	7.6	71.8
and Chili Sauce	12.6	43.7	14.0	70.3
and Cranberry				
Sauce	11.0	43.1	20.5	74.6
a la Cream	11.9	46.5	7.0	65.4
Croquettes	13.4	52.9	14.8	81.1
Cutlets	11.3	36.5	12.7	60.5
Fricassee	9.0	39.2	5.9	54.1
and Jelly	11.9	46.8	22.6	81.3
with Mint Sauce	13.1	51.4	22.1	86.6
and Tomato Sauce	11.5	48.6	6.8	66.9
Oaten Cakes	13.6	37.1	66.7	117.4
Oatmeal, Boiled	3.2	1.3	13.0	17.5
Oatmeal Hermits	9.0	55.8	73.3	139.1
Gruel	.8	.8	3.1	4.7
and Mushroom				
Soup	2.0	9.5	5.0	16.5
Water	.8	.3	3.3	4.4
Okra Creamed				
on Toast	3.8	12.9	20.4	37.1
Soup	1.0	.4	4.1	5.5
Soup, Cream of	1.9	9.9	4.7	16.5
and Tomatoes	1.7	4.2	6.9	12.8
Olive and Egg				
Sandwich	6.0	62.0	27.0	95.0
and Nut				
Sandwich	7.3	80.2	31.2	118.7

	Protein	Fats
Oil	....	264.1
Ripe E. P.	1.9	63.8
Ripe A. P.	1.6	53.6
and Yogurt Cheese Sandwiches	11.3	42.3
Omelet, Egg	10.2	29.9
French	13.5	24.7
Puff	13.1	22.9
To-fu	5.3	4.4
Onions, Green E. P.	1.1	.3
E. P.	1.8	.8
A. P.	1.6	.8
Baked	1.8	6.1
Boiled	1.4	7.3
Creamed	2.3	5.4
in Cream	2.2	14.2
Duchess	4.6	30.0
and Egg in White Sauce	4.2	11.9
and Potato Hash	1.9	8.9
Scalloped	3.6	21.1
Souffle	5.6	19.4
Soup, Creamed of Browned	3.1	15.7
Stewed	2.4	11.7
Stuffed	2.4	10.4
on Toast	4.9	11.6
Young	1.8	.8
Oranges E. P.	.9	.5
A. P.	.7	.3
Apple and Date Salad	2.1	10.1
Cake	3.4	14.9
Charlotte	2.8	11.2
Compote	.5	.3
Filling	3.5	18.7
Fluff	1.2	.1
Frosting	.4	1.0
Gelée	...	....
Jelly	....	....
Juice	....	....

	Protein	Fats	Carbo.	Total
Mold	.3	.2	29.9	30.4
Roly-Poly	5.8	12.9	58.6	77.3
Pie	4.6	15.8	31.8	52.2
Salad	1.4	1.9	27.0	30.3
Sauce	1.8	19.0	39.8	60.6
Shortcake	2.3	28.1	15.8	46.2
Sponge Cake	6.3	5.9	74.8	87.0
Water Ice	....	....	30.4	30.4
Ornamental Frosting	2.9	.1	91.1	94.1
Parisian Sweets	8.7	52.9	66.5	128.1
Parkerhouse Rolls	9.8	12.5	57.8	79.6
Parsnips, Browned	1.8	8.2	14.8	24.8
Creamed	2.8	13.3	13.9	30.0
Mashed	1.9	8.1	15.3	25.3
Souffle	6.1	20.8	14.2	41.1
Pastry, Plain	7.0	66.3	48.3	121.6
Strips	6.2	50.7	59.3	116.2
Peas (Green)				
with Asparagus	2.2	10.0	7.8	20.0
(Green) Boiled	6.4	8.2	19.1	33.7
Beets in Aspic	2.3	6.7	7.6	16.6
with Carrots	3.7	9.8	11.4	24.9
and Celery	2.0	6.2	6.2	14.4
Creamed	6.7	10.9	17.1	34.7
with Cream	6.0	18.5	13.9	38.4
and Macaroni	3.9	11.6	15.0	30.5
Patties	5.3	12.4	13.8	31.5
and Potatoes (New)	4.3	7.8	16.5	28.6
and Potato Soup	4.2	8.6	14.0	26.8
(Split) Purée	7.4	14.3	17.1	38.8
with Rice	2.9	27.4	18.7	49.0
Souffle	7.4	22.6	10.3	40.3
(Split) Soup	4.2	4.1	11.2	19.5
(Split) Soup, Cream of	4.4	5.2	10.8	20.4
(Green) Soup	3.6	4.4	8.9	16.9
(Green) Soup, Cream of, No. 1	2.7	6.6	7.0	16.3
(Green) Soup ..... Cream of No. 2	3.2	7.9	6.8	17.9

	Protein	Fat
Soup, Cream of Scotch	7.8	12.4
Toast	6.7	5.6
Peaches E. P.	.8	.3
A. P.	.6	.3
Cobbler	2.6	10.9
Bavarian Cream	1.2	16.5
Canned	.5	.1
Sliced Canned	.6	.2
and Cream with Rice Biscuit	3.2	4.3
Custard	3.9	8.6
Frozen	.3	.1
Peach Gelee	....	...
Ice Cream	3.2	16.8
Jellied	1.3	5.8
Juice	....	...
Pudding	2.5	15.9
Preserved	.6	.2
Sauce	.8	.3
Sherbet	.8	.2
Shortcake	2.2	25.6
Toast	4.2	1.5
Peanuts	29.3	98.4
Butter Sandwich	13.2	85.7
Roasts	15.4	45.9
Pears, Fresh E. P.	.7	1.3
A. P.	.6	1.0
Juice	....	...
Baked	.6	5.9
Chips	.7	.5
Gelée	....	...
Preserved	.5	1.0
Sauce	.3	.8
Pecans E. P.	10.9	179.8
A. P.	5.8	96.6
Perfection Salad	2.4	13.2
Persimmons, Fresh E. P.	.9	1.8
Persian Salad	1.4	1.9
Pie, Apple	2.5	22.1
Apple Cream, New England	2.7	19.8

	Protein	Fats	Carbo.	Total
Apple and Nut	8.7	16.0	28.0	52.7
Blackberry	3.0	22.6	37.2	62.8
Blueberry	3.1	26.8	51.8	81.7
Cherry	2.8	17.8	41.2	61.8
Chestnut	7.5	25.1	42.4	75.0
Chocolate	4.2	16.8	24.1	45.1
Cocoanut Cream	7.3	43.6	34.3	85.2
Custard	6.1	25.1	22.8	54.0
Date Cream	5.0	19.3	33.6	57.9
Lemon	2.2	27.3	21.3	50.8
Nut Meat	11.6	25.6	17.3	54.5
Orange	4.6	15.8	31.8	52.2
Pineapple	3.6	15.2	40.1	58.9
Pumpkin	4.0	14.8	22.9	41.7
Raspberry, Black	3.1	20.1	37.9	61.1
Sanitarium Mince	4.9	27.6	23.1	55.6
Squash	4.0	15.0	23.9	42.9
Strawberry	2.6	21.0	31.2	54.8
Sweet Potato	4.6	22.5	37.7	64.8
Vanilla Cream	5.4	21.9	33.0	60.3
Pine Nuts, Pignolias	38.4	126.0	7.8	172.2
Pine Nut Croquettes	25.5	71.2	13.7	110.4
Roast	26.1	72.3	28.1	126.5
Pineapple, Fresh	.5	.8	11.0	12.3
Canned	.3	.5	40.6	41.4
and Celery Sandwich	43.8	46.9	36.6	127.3
and Cheese Sandwich	7.7	64.7	36.2	108.6
Cream	.7	8.5	27.0	36.2
Cream, Dessert	2.6	12.9	23.6	39.1
Fluff	2.2	10.2	24.8	37.2
Frappe	.1	.2	21.0	21.3
Gelée	....	....	14.5	14.5
Ice Cream	3.1	17.2	16.7	37.0
Jelly	....	....	44.9	44.9
Juice	....	....	21.8	21.8
and Nut Salad	2.5	24.4	30.6	57.5
Pie	3.6	15.2	40.1	58.9
Sauce	.5	1.8	41.3	43.6
Shortcake	2.0	26.9	32.2	61.1

	Protein	Fats
and Strawberry Salad	1.1	.8
Tapioca Pudding	.1	.4
Pinon	16.6	157.9
Piquant Sauce	7.0	24.9
Pistachios	25.3	137.7
Plain Custard	4.3	10.7
Plums, Fresh	1.1	....
Gelée	.7	....
Toast	3.7	1.1
Pomegranates	1.7	4.1
Popcorn	12.1	12.8
Porridge, Bran	3.1	2.0
Bran with Apple Sauce	2.6	1.3
Potato, Baked	3.1	.3
Cream Baked	3.2	12.1
Balls En Surprise	6.5	41.4
Boiled	2.5	.3
Broth, Savory	1.2	5.8
Browned	2.5	8.0
Cakes	5.0	21.7
Cakes with Gravy	1.6	11.1
Creamed Baked	3.2	12.1
(New) in Cream	2.6	17.9
Sliced in Cream	3.2	7.7
and Celery Hash	2.4	7.0
and Celery Salad	3.5	8.8
Chowder	2.5	9.8
Croquettes	5.4	19.9
Hashed Brown	2.7	11.6
Au Gratin	5.1	21.4
(Baked) Gruel	.6	.1
(Baked) Cream Gruel	3.4	17.0
and Lentil Loaf	5.9	9.3
Loaf	3.3	12.3
Lyonnaise	2.4	14.7
a la Maitre d'Hotel	3.6	11.5
Mashed	2.3	4.3
Minced	3.0	12.8

	Protein	Fats	Carbo.	Total
and Onion Hash	1.9	8.9	14.4	25.2
Parisian	2.5	9.0	16.7	28.2
and Peas (New)	4.3	7.8	16.5	28.6
and Pea Soup	4.2	8.6	14.0	26.8
and Protose Croquettes	7.7	9.0	14.7	31.4
Puff	1.2	17.6	.5	19.3
and Rice Croquettes	3.1	4.3	20.2	27.6
Salad	3.5	11.4	17.6	32.5
Salad, German	2.2	7.0	18.3	27.5
Savory	2.2	7.0	18.3	27.5
Scalloped	3.1	10.7	14.1	27.9
Soup	.8	4.6	6.6	12.0
Soup, Browned	3.4	15.2	12.2	30.8
Soup, Cream of No. 1	2.5	7.4	11.0	20.9
Soup, Cream of No. 2	2.2	3.1	11.3	16.6
Soup, Savory	1.1	1.3	5.0	7.4
Stuffed	3.5	8.4	26.0	37.9
Pretzels, Tea	12.6	65.6	92.9	171.1
Protose, Braised	16.6	22.9	8.1	49.4
Broiled	25.5	24.5	10.1	60.1
Broth	8.7	8.0	4.9	21.6
Chipped in Cream	18.3	27.1	10.5	55.9
Croquettes	27.5	33.5	16.1	77.1
and Nut Cutlets	13.5	13.9	10.9	38.3
Fillet	10.7	14.3	6.7	31.7
Gravy	5.8	10.5	3.6	19.9
with Gravy	17.6	20.3	8.4	46.3
Hash	8.9	21.2	19.2	49.3
Hash with Rice and Peas	11.3	13.8	17.2	42.3
with Mayonnaise	19.7	27.6	9.7	57.0
with Mushrooms	18.3	16.7	9.3	44.3
or Nut Cutlets	14.7	17.7	10.8	43.2
Panned	21.6	30.8	11.7	64.1
and Potato Croquettes	7.7	9.0	14.7	31.4
Roast with				

	Protein	Fat
Dressing	20.8	28.4
Sandwich	11.3	56.1
Steak with Onion	21.6	34.1
Prunes, Fresh E. P.	1.0	....
Fresh A. P.	.8	....
Dried E. P.	2.4	....
Dried A. P.	2.0	....
Fluff	1.2	7.8
Fritters	3.6	23.6
Gelée	.4	.2
Hydrated	.8	....
Jellied	1.3	9.1
Parfait	2.5	21.9
Souffle	3.5	9.8
Stewed	.7	....
Toast	3.7	2.5
Pudding, Apple Tapioca	.3	.7
Steamed Bread	4.3	15.6
Cabinet	6.0	32.1
Caramel Cornstarch	2.4	6.5
Cocoanut Blanc Mange	3.7	22.8
Corn	4.9	13.7
Cornstarch	4.1	10.2
Cottage	6.4	23.3
Date	6.9	19.6
Farina Blanc Mange	3.6	9.3
Fig	4.9	9.2
Fig Tapioca	2.3	.4
Granola Fruit	4.9	9.2
Steamed Fruit	3.2	20.1
Graham	6.2	6.2
Indian	6.2	12.2
Baked Indian	5.4	13.3
Lemon Cream	4.3	10.7
Log Cabin	5.1	11.7
Peach	2.5	15.9
Pineapple Tapioca	.1	.4

	Protein	Fats	Carbo.	Total
Plain Rice	6.3	13.7	31.1	51.1
Cream of Rice	5.3	11.5	28.3	45.1
Queen of	4.9	14.4	29.1	48.4
Rice with Orange Compote	3.4	10.8	27.2	41.4
St. James	5.5	14.1	61.7	91.3
Snow	4.0	8.2	17.8	30.0
Tapioca Custard	4.3	10.5	25.1	39.9
Vevey	5.5	32.3	50.4	88.2
Puffs, Gluten	10.9	43.6	36.3	90.3
Aerated Whole-wheat	8.9	18.5	36.2	63.6
Pumpkin Pie	4.0	14.8	14.8	41.7
Punch, Fruit	.1	.3	28.4	28.8
Spiced	....	....	28.5	28.5
Queen of Puddings	4.9	14.4	29.1	48.4
Quince Jelly	....	....	73.7	73.7
Sauce	.3	.9	24.4	25.6
Radishes E. P.	1.5	.3	6.6	8.4
Raisins E. P.	2.9	8.4	86.3	97.6
A. P.	2.6	7.7	77.7	88.0
Gems	7.4	17.8	43.0	68.2
Sauce	.7	25.0	42.6	68.3
Rarebit, Yogurt Cheese	10.6	46.2	20.6	77.4
Raspberries, Black	1.9	2.6	14.3	18.8
Red	1.1	....	14.3	15.4
Gelée	.7	....	15.6	16.3
Jam, Red	.9	....	102.2	103.1
Juice, Black	....	....	....	23.7
Juice, Red	....	....	....	29.4
Nectar	....	....	16.9	16.9
Pie	3.1	20.1	37.9	61.1
and Peach Jelly	....	....	7.2	7.2
Sauce, Red	....	....	27.7	27.7
Syllabub	2.4	20.4	20.3	43.1
Toast, Red	3.9	1.1	37.9	42.8
Relish, Celery	1.7	1.0	10.6	13.3
Ribbon Sandwich	8.0	46.7	49.0	103.7
Rice Biscuit	8.6	.3	92.9	101.8
Biscuit with Peaches and Cream	3.2	4.3	35.3	42.8

	Protein	Fats
Boiled and Creole Sauce	2.7	6.9
A La Carolina	10.0	35.6
and Cheese	6.7	20.5
with Compote of Fruit	1.7	.4
Griddle Cakes	8.7	4.5
Meal Gruel	.9	1.5
Muffins	7.9	24.0
Nut Croquettes	11.8	10.9
and Nut Soup	1.5	4.6
Patties	4.2	13.8
Patties with Tomato Sauce	3.5	14.7
Patties with White Sauce	4.2	16.7
with Peas	2.9	27.4
and Potato Croquettes	3.1	4.3
with Prune Fluff	3.5	13.7
Pudding, Plain	6.3	13.7
Pudding, Cream of	5.3	11.5
Pudding with Orange Compote	4.3	10.8
Savory	2.7	5.7
Special	1.2	4.6
Soup, Cream of	2.6	8.4
Steamed and Creole Sauce	6.4	8.7
Steamed with Raisins	2.4	1.5
Roast. Cereal	16.0	27.4
Chestnut	9.4	20.0
Corn	8.5	9.5
Rolled Oats, Boiled	2.4	2.4
Oats with Apple	2.9	3.4
Roxbury Cakes	8.8	42.3
Royal Salad	11.7	51.9
Scallop	8.4	19.1
Rye Flakes	14.7	5.4
Flake Gruel	1.1	.4

	Protein	Fats	Carbo.	Total
St. James Pudding	5.5	14.1	61.7	91.3
Salad, Apple and Celery	1.4	1.9	19.5	22.8
Apple, Cheese and Nut	6.7	77.4	8.5	92.6
Apple and Date	1.9	11.4	32.4	45.7
Apple, Date and Orange	2.1	10.1	26.3	38.5
Apricot	4.1	67.3	13.0	84.4
Asparagus Luncheon	2.2	59.6	3.4	65.2
Banana Walnut	2.6	13.1	24.2	39.9
Bean	2.1	6.5	6.9	15.5
Beet	2.8	4.2	8.4	15.4
Berkeley	.6	1.1	29.6	31.3
Bulgarian	12.9	91.0	8.2	112.1
Cabbage	2.1	18.4	8.5	29.0
California Raisin	1.7	3.6	37.7	43.0
Cauliflower	2.5	8.9	6.0	17.4
Cauliflower and Tomato	1.6	19.5	5.1	26.2
Celery	2.3	12.8	5.4	20.5
Celery and Grapefruit	1.6	7.0	8.7	17.3
Celery and Peas	3.2	9.9	8.6	21.7
Celery and Potato	3.5	8.8	15.2	27.5
Celery and Tomato	1.4	4.4	4.9	10.7
Cheese and Tomato	9.1	7.3	5.3	21.7
Cherry and Filbert	4.3	36.5	17.9	58.7
Combination Green	.9	9.4	4.2	14.5
Cottage	8.9	4.7	10.8	24.4
Cucumber and Tomato	.9	6.2	3.7	10.8
Date and Walnut	8.7	58.9	53.0	120.6
French	2.6	8.7	13.7	25.0
Fruit	1.5	2.4	26.1	30.0
Fruit Cheese	9.9	96.2	30.7	136.8
Fruit A La Cream	1.4	8.5	28.1	38.0
Grape	3.6	31.8	6.8	42.2

	Protein	Fat
Macedoine	1.3	32.9
Fruit Macedoine No. 1	.9	1.0
Fruit Macedoine No. 2	.8	.5
Orange	1.4	1.9
Perfection	2.4	13.2
Persian	1.4	1.9
Pineapple and Nut	2.5	24.4
Pineapple and Strawberry	1.1	.8
Potato	3.5	11.4
German Potato	2.2	16.7
Potato and Beet	2.7	2.5
Royal	11.7	51.9
Soy Bean	10.7	20.8
String Bean	.9	49.7
Summer	2.2	11.7
Swiss	1.1	32.6
Tomato	1.4	4.9
in Tomato Cups	1.5	6.2
Vegetable	1.0	11.3
Waldorf	3.5	27.0
Waterlily	13.5	38.4
Yogurt Cheese	17.3	80.5
Salpicon of Fruit	....	...
Sandwich, Almond	12.4	40.4
Apple Jelly	5.9	35.6
Apricot	6.8	29.0
Baked Bean	6.8	51.9
Celery	5.3	56.7
Celery and Pineapple	43.8	46.9
Cheese and Marmalade	7.1	45.3
Cheese and Pineapple	7.7	64.7
Cheese and Tomato	9.3	3.7
Chili	11.1	24.5
Cottage Cheese	10.7	61.4

	Protein	Fats	Carbo.	Total
Cucumber	.7	49.0	27.8	81.5
Date	6.5	21.2	66.4	94.1
Egg	9.1	56.5	27.3	92.9
Egg and Olive	6.0	62.0	27.0	95.0
Fig and Nut	9.3	33.1	50.6	93.0
Fruit and Whipped Cream	3.5	8.3	25.7	37.5
Jelly and Yogurt	7.1	57.5	40.3	104.9
Lettuce	5.5	59.1	32.9	97.5
Nut and Olive	7.3	80.2	31.2	118.7
Olive and Yogurt Cheese	11.3	42.3	29.8	83.4
Peanut Butter	13.2	85.7	36.5	135.4
Protose	11.3	56.1	29.2	96.6
Ribbon	8.0	46.7	49.0	103.7
Summer	11.8	16.2	30.4	58.4
Tomato	3.9	39.8	23.6	67.3
Sanitarium Mince Pie	4.9	27.6	23.1	55.6
Salad Dressing	.2	96.1	8.6	104.9
Saniterrapin Soup	2.5	9.7	1.7	13.9
Sauce, Bechamel	3.7	27.3	9.1	40.1
Brown	1.0	21.9	5.1	28.0
Brown Sugar	.1	13.5	71.1	84.7
Drawn, Butter	4.9	51.9	3.3	60.1
Cheese	5.5	28.2	7.3	41.0
Chili	4.2	1.5	33.4	39.1
Chocolate	7.6	116.3	470.8	594.7
Cream	3.9	21.3	10.2	35.4
Creole	1.9	24.8	9.3	36.0
Custard	4.1	10.2	21.6	35.9
Egg	5.2	22.4	6.8	34.4
Golden	1.8	60.5	60.5	122.8
Hard	.5	86.8	68.1	155.4
Hollandaise	4.0	123.4	....	127.4
Lemon	.9	18.2	82.8	101.9
Lemon Cream	3.7	49.5	40.9	94.1
Maple	.1	11.4	44.3	55.8
Mint	....	....	20.7	20.7
Mushroom	1.7	26.9	5.9	34.5
for Nut Sausage	6.8	42.0	11.9	60.7
Orange	1.8	19.0	39.8	60.6

	Protein	Fat
Piquant	7.0	24.9
Tomato	1.6	17.1
Tomato Cream	2.8	24.2
Vanilla	.5	14.9
for Vegetables	2.3	22.7
White	4.4	30.1
Thin White	4.2	23.8
Savora Bouillon	.7	.1
Broth	.5	2.2
Rice Soup	1.6	3.5
Savory Celery on Toast	1.2	9.2
Potato Broth	1.2	5.8
Roast	21.8	26.2
Scotch Brose	3.1	3.1
Bran Brose	3.9	3.1
Sherbet, Cranberry	.3	.6
Grape	.8	13.9
Lemon	.9	....
Milk	2.3	6.3
Mint	.6	....
Peach	.8	.2
Shredded Wheat	11.9	3.6
Slaw, Cold	2.9	8.4
Hot	1.1	8.5
Snow Pudding	4.0	8.2
Snowflake Toast	5.9	13.9
Soup, Cream of Almond	6.2	28.9
Cream of Asparagus	3.3	16.1
Barley	.9	5.6
Cream Barley	1.8	11.0
Beet, Russian	.7	6.7
Bean	6.5	4.6
Cream of Bean	1.9	5.6
Bean and Tapioca	3.7	7.2
Cream of Celery	2.0	15.0
Celery and Vegetable Oyster	1.2	14.8
Celery and Tomato	2.1	5.6

	Protein	Fats	Carbo.	Total
Cream of Chestnut	4.5	17.9	14.7	37.1
Cream of Corn ...	3.6	13.2	12.5	29.3
Cream Crecy	2.7	11.9	6.5	21.1
Creole	1.6	3.9	8.3	13.8
Cream of Dasheen.	4.9	11.1	6.3	22.3
Fruit	.5	.7	31.4	32.6
Italian	1.1	.6	5.1	6.8
Kidney Bean	2.6	4.6	7.1	14.3
Lentil	1.0	3.4	8.9	13.3
Lentil, Cream of ..	9.3	21.7	20.3	51.3
Lettuce, Cream of	2.6	13.8	4.6	21.0
Lima Bean	2.1	3.8	8.0	13.9
Lima Bean, Cream of....	3.9	8.9	10.5	23.3
Macaroni and Tomato	2.1	7.6	9.0	18.7
Manhattan	2.9	17.4	11.4	31.7
Mock Chicken	.9	13.1	5.8	19.8
Mushroom and Oatmeal	1.9	10.1	5.3	17.3
Noodle	3.7	11.8	15.2	30.7
Nut French	.9	1.9	2.8	5.6
Nut and Rice	1.5	4.6	5.6	11.7
Okra	1.0	.4	4.1	5.5
Okra, Cream of ..	1.9	9.9	4.7	16.5
Cream of Brown Onion	3.1	15.7	10.6	29.4
Green Pea	3.6	4.4	8.9	16.9
Green Pea, Cream of No. 1...	2.7	6.6	7.0	16.3
Green Pea, Cream of No. 2...	3.2	7.9	6.8	17.9
Cream of Scotch Peas	7.8	12.4	20.2	40.4
Split Pea	4.2	4.1	11.2	19.5
Split Pea, Cream of	4.4	5.2	10.8	20.4
Potato	.8	4.6	6.6	12.0
Potato, Cream of No. 1 ..	2.5	7.4	11.0	20.9
Potato, Cream of No. 2....	2.2	3.1	11.3	16.6

	Protein	Fats
Browned Potato ..	3.4	15.2
Peas and Potato ..	4.2	8.6
Potato Savory	1.1	1.3
Rice, Cream of	2.6	8.4
Saniterrapin	2.5	9.7
Savora Rice	1.6	3.5
Soy Bean, Cream of	16.7	32.3
Soy Bean and Tomato	10.9	16.1
Spinach, Cream of	3.7	17.9
Squash, Cream of .	2.9	7.2
Sweet Potato, Cream of	1.3	6.9
Tomato	1.5	4.3
Tomato, Cream of	2.7	13.2
Tomato and Macaroni	2.1	7.6
Tomato Vermicelli	1.6	.7
Vegetable	.8	6.5
Thick Vegetable ..	4.6	11.3
Vegetable, with Noodles	.7	3.9
Vegetable Oyster, Cream of No. 1....	2.7	17.9
Vegetable Oyster, Cream of No. 2....	2.0	13.7
Soy Bean Biscuit	66.1	23.5
Salad	10.7	20.8
Soup, Cream of ..	16.7	32.3
and Tomato Soup	10.9	16.1
Spaghetti Milanaise	3.9	12.9
and Tomatoes	2.5	6.1
Spanish Cream	4.9	11.4
Eggs	8.9	36.7
Gravy	1.5	14.0
Meat Balls	8.7	10.2
Spiced Punch	....	....
Spinach Bechamel	2.8	16.0
Boiled	2.4	7.5

	Protein	Fats	Carbo.	Total
Creamed	2.7	17.7	5.1	25.5
Creamed on Toast	7.1	11.9	20.5	39.5
Souffle	6.4	21.1	7.6	35.1
Soup, Cream of	3.7	17.9	6.8	28.4
on Toast	5.3	14.9	19.0	39.2
Sponge Cake	8.9	10.7	77.9	97.3
Squash, Baked				
Hubbard	1.4	29.0	14.0	44.4
Mashed Hubbard	1.0	25.2	10.9	37.1
Pie	4.0	15.0	23.9	42.9
Soup, Cream of	2.9	7.2	9.9	20.0
Mashed Summer	1.0	12.8	4.1	17.9
Strawberries, Fresh	1.1	1.5	8.4	11.0
Canned	.6	.9	55.4	56.9
Jelly and Banana	1.6	.5	20.8	22.9
Gelée	.6	....	41.9	42.5
Ice Cream	4.3	22.5	13.3	40.1
Juice	....	....	24.5	24.5
Pie	2.6	21.0	31.2	54.8
and Pineapple Salad	1.1	.8	18.3	20.2
Preserves	.7	.9	74.6	76.2
Shortcake	4.3	16.2	40.4	60.9
Toast	3.5	1.1	39.7	44.3
String Bean Salad	.9	49.7	3.9	54.5
Bean Souffle	5.3	22.2	3.2	30.7
Bean and Cucumber Salad	1.0	21.1	22.4	44.5
Succotash	1.9	7.3	10.8	20.0
Sugar, Granulated	....	....	113.4	113.4
Brown	....	....	107.7	107.7
Maple	....	....	93.9	93.9
Meltose	2.0	.3	101.9	104.2
Milk	....	....	113.4	113.4
Summer Salad	2.2	11.7	6.4	20.3
Sandwiches	11.8	16.2	30.4	58.4
Sunshine Cake	12.1	18.8	51.1	82.0
Sweet Potatoes,				
Creamed	3.5	12.0	20.6	36.1
Baked	2.0	1.8	31.1	34.9
Browned	1.9	8.4	32.7	43.0

	Protein	Fat
Glazed	2.4	8.3
Mashed	3.3	20.2
Pie	4.6	22.5
Soup, Cream of	1.3	6.9
Swiss Chard	2.4	17.2
Swiss Salad	1.1	32.6
Tapioca Custard Pudding	4.3	10.5
Tea Pretzels	12.6	65.6
Toast, Apple	5.7	.9
French Apple	6.2	9.5
Apricot	4.7	.3
Asparagus Tips	3.8	59.7
Banana	3.5	2.1
Blackberry	3.7	2.9
Blueberry	3.6	1.5
Breakfast	11.4	27.5
Cherry	4.0	1.8
Creamed Celery	4.8	7.7
Date	4.0	4.8
Scrambled Eggs on	9.8	20.3
Grape	2.9	1.2
Green Lima Bean	5.9	6.3
Neopolitan	5.2	12.4
Creamed Okra	3.8	12.9
Onion	4.9	11.6
Peas	4.2	5.7
Peach	4.2	1.5
Plum	3.7	1.1
Prune	3.7	2.5
Red Raspberry	3.9	1.1
Savory Celery	1.2	9.2
Snowflake	5.9	13.9
Spinach	5.3	14.9
Spinach Bechamel	4.9	11.9
Spinach, Creamed	7.1	11.9
Strawberry	3.5	1.1
Tomato	9.3	3.7
Tomato, Baked on	4.3	9.4
Tomato, Cream of	4.9	17.4
Turnips, Creamed	3.5	9.7

	Protein	Fats	Carbo.	Total
To-fu Omelet	5.3	4.4	4.1	13.8
Tomatoes, Fresh	1.0	1.0	4.4	6.4
Baked	1.5	22.2	4.5	28.2
Bisque No. 1	3.4	10.5	3.4	17.3
Bisque No. 2......	1.4	9.0	5.9	16.3
Bouillon	1.2	.5	5.3	7.0
Breaded	2.1	4.3	9.7	16.1
and Cauliflower Salad	1.6	19.5	5.1	26.2
and Celery Salad .	1.4	4.4	4.9	10.7
and Celery Soup ..	2.1	5.6	8.3	18.1
and Cheese Salad ..	9.1	7.3	5.3	21.7
Cheese Sandwich ..	9.3	3.7	63.4	76.4
and Cucumber Salad	.9	6.2	3.7	10.8
and Corn Stewed ..	2.3	1.8	13.0	17.1
au Gratin	4.9	26.4	11.9	43.2
Jelly	1.1	.4	7.1	8.6
with Macaroni	3.1	8.0	15.9	27.0
and Macaroni Soup	2.1	7.6	9.0	18.7
and Okra	1.7	4.2	6.9	12.8
Salad	1.4	4.9	4.9	11.2
Sandwiches	3.9	39.8	23.6	67.3
Sauce	1.6	17.1	6.7	25.4
Sauce, Cream	2.8	24.2	7.6	34.6
Soup	1.5	4.3	6.6	12.4
Soup, Cream of ..	2.7	13.2	4.4	20.3
and Soy Bean Soup	10.9	16.1	10.1	37.1
and Spaghetti	2.5	6.1	13.4	22.0
Stewed	3.0	17.0	11.0	31.0
Stuffed No. 1	2.3	30.8	8.0	41.1
Stuffed No. 2	2.4	7.1	11.4	20.9
Toast	9.3	3.7	63.4	76.4
Toast, Cream	4.9	17.4	26.2	48.5
(Baked) on Toast.	4.3	9.4	21.9	25.6
Vermicelli Soup ..	1.6	.7	4.6	6.9
Turkish, Pilaf	2.7	19.5	22.7	44.9
Turnips Creamed	1.8	8.3	8.5	18.6
Creamed on Toast	3.5	9.7	17.5	30.6
Mashed	1.5	7.3	9.2	18.0
Purée	1.7	11.5	8.4	25.6

	Protein	Fats
Vanilla Ice Cream	3.8	18.3
Cream Pie	5.4	21.9
Sauce	.5	14.9
Vegetable Bouillon	2.4	.4
Ham	14.1	55.8
Meat Pressed	28.4	57.5
and Nut Stew	11.4	23.6
Oysters, Buttered	1.0	13.8
Oysters, Creamed	2.2	11.7
Oyster Fritters	2.7	29.9
Oyster Scalloped	2.9	14.7
Oyster Souffle	5.9	24.8
Oyster Soup	.4	6.2
Oyster Soup, Cream of No. 1	2.7	17.9
Oyster Soup, Cream of No. 2	2.0	13.7
Salad	1.0	11.3
Soup	.8	6.5
Soup, Thick	4.6	11.3
Vevey Pudding	5.5	32.3
Wafers, Almond	18.0	102.4
Waffles	16.6	28.8
Waldorf Salad	3.5	27.0
Walnuts, California E. P.	20.9	164.2
Cal. Black E. P.	31.3	143.6
English E. P.	20.9	164.2
and Banana Salad	2.6	13.1
Croquettes	17.5	88.4
and Date Salad	8.7	58.9
Roast	8.5	42.4
Washington Chowder	2.3	8.8
Water Frosting	.4	1.0
Waterlily Salad	13.5	38.4
Watermelon E. P.	.5	.5
Wheat Bread	10.4	3.3
Brose	1.0	.3
Flakes	9.5	4.3
Flake Gruel	.7	.3
White Clover Honey	.5	....
Layer Cake	6.2	36.5

	Protein	Fats	Carbo.	Total
Sauce	4.4	30.1	13.1	47.6
Sauce, Thin	4.2	23.8	8.3	36.3
Sponge Cake	10.6	.9	60.1	71.6
Wholewheat Gems	9.3	14.4	45.9	69.6
Puffs, Aerated	8.9	18.5	36.2	63.6
Yogurt Buttermilk	4.0	.8	6.0	10.8
Buttermilk and Cream	3.6	16.3	5.7	25.6
Cheese	20.3	82.8	3.9	107.0
Cheese and Olive Sandwiches	9.3	3.4	63.4	76.4
Cheese Rarebit	10.6	46.2	20.6	77.4
Cheese Salad	17.3	80.5	5.0	102.8
Ice Cream	2.0	18.1	24.4	44.5
Jelly	2.2	7.3	5.1	14.6
and Jelly Sandwiches	7.1	57.5	40.3	104.9

TABLE XLV.

Percentage Composition of Foodstuffs
(Calories) per Ounce

(The letters E. P. stand for edible portion and A. P.

	Protein		Fat	
	%	Cal. per oz.	%	Cal. per oz.
Acorns E. P.	8.1	9.2	37.4	95.4
A. P.	5.2	5.9	24.1	61.5
Acorn kernel	4.2	4.8	5.4	13.8
Almonds E. P.	21.0	23.8	54.9	139.9
A. P.	11.5	13.0	30.2	77.0
Apples E. P.	.4	.5	.5	1.3
A. P.	.3	.3	.3	.8
dried, A. P.	1.6	1.8	2.2	5.6
crab, canned A. P.	.3	.3	2.4	6.1
sauce, canned A. P.	.2	.2	.8	2.0
Apricots E. P.	1.1	1.2	...	...
A. P.	1.0	1.1	...	...
dried, A. P.	4.7	5.3	1.0	2.6
canned A. P.	.9	1.0	...	...
sauce, canned A. P.	1.9	2.2	1.3	3.3
Artichokes A. P.	2.6	2.9	.2	.5
canned A. P.	.8	.9	...	...
Asparagus, fresh A. P.	1.8	2.0	.2	.5
canned A. P.	1.5	1.7	.1	.3
bouillon, canned A. P.	2.2	2.5	.1	.3
cooked A. P.	2.1	2.4	3.3	8.4
soup, cream of canned A. P.	2.5	2.8	3.2	8.2
Avocado	2.2	2.5	17.3	44.1
Banana E. P.	1.3	1.5	.6	1.5
A. P.	.8	.9	.4	1.0
Bacon, smoked E. P.	10.5	11.9	64.8	165.2
A. P.	9.5	10.8	59.4	151.5
Barley meal and flour	10.5	11.9	2.2	5.6
entire	9.0	10.2	1.6	4.1
pearled	8.5	9.6	1.1	2.8
Bass, black, whole	20.6	23.4	1.7	4.3
Bean, adzuki	21.0	23.8	.7	1.8
baked, canned A. P.	6.9	7.8	2.5	6.4
butter, green	4.7	5.3	.3	.8
dried A. P.	22.5	25.5	1.8	4.6
frijoles A. P.	21.9	24.8	1.3	3.3
little green, canned A. P.	1.2	1.4	.1	.3
haricots. verts canned A. P.	1.1	1.2	.1	.3
jack	23.8	27.0	2.6	6.6
red kidney, canned A. P.	7.0	7.9	.2	.5
lima, dried	18.1	20.5	1.5	3.8
lima, fresh A. P.	3.2	3.6	.3	.8
lima, canned A. P.	4.0	4.5	.3	.8
mesquite, dry, A. P.	12.2	13.8	2.5	6.4
and pod, mesquite	13.0	14.7	3.1	7.9
mung	23.8	27.0	2.0	5.1
soup, homemade A. P.	3.2	3.6	1.4	3.6
soy	39.5	44.8	18.5	47.2
string, cooked E. P.	.8	.9	1.1	2.8
string, fresh E. P.	2.3	2.6	.3	.8
string, fresh A. P.	2.1	2.4	.3	.8
string, canned A. P.	1.1	1.2	.1	.3
wax, canned A. P.	1.0	1.1	.1	.3
Beechnut E. P.	21.9	24.8	57.4	146.4
A. P.	13.0	14.7	34.0	86.7
Beef, brisket, med. fat E. P.	15.8	17.9	28.5	72.8
A. P.	12.0	13.6	22.3	56.9

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[*] This table is compiled from Bulletin No. 28 of the U.
Sherman's Chemistry of Foods and other authoritative sou

	Protein		Fat		Carbo.		Total	Lime	Iron
	%	Cal. per oz.	%	Cal. per oz.	%	Cal. per oz.	Cal. per oz.	%	%
chuck, av. E. P.	19.2	21.8	15.4	39.3	...	...	61.1	.015	.0029
A. P.	15.8	17.9	12.5	31.9	...	...	49.8	.012	.0024
corned, av. E. P.	15.6	17.7	26.2	66.8	...	...	84.5	.012	.0023
A. P.	14.3	16.2	23.8	60.7	...	...	76.9	.011	.0021
cross ribs, av. E. P.	15.9	18.0	28.2	71.9	...	...	89.9	.012	.0024
A. P.	13.8	15.6	24.8	63.2	...	...	78.8	.011	.0021
dried, salted and smoked E. P.	30.0	34.1	6.5	16.6	.4	.5	51.2	.023	.0045
smoked A. P.	26.4	29.9	6.9	17.6	...	...	47.5	.020	.0040
flank, lean E. P.	20.8	23.6	11.3	28.8	...	...	52.4	.016	.0031
A. P.	20.5	23.2	11.0	28.1	...	...	51.3	.016	.0031
forequarter, lean E. P.	18.9	21.4	12.2	21.1	...	...	52.5	.014	.0028
A. P.	14.7	16.7	9.5	24.2	...	...	40.9	.011	.0022
forequarter, med. fat A. P.	14.5	16.4	17.5	44.6	...	...	61.0	.011	.0022
fore shank, E. P.	22.0	24.9	6.1	15.6	...	...	40.5	.017	.0033
A. P.	14.0	15.9	3.9	9.9	...	...	25.8	.011	.0021
heart E. P.	16.0	18.1	20.4	52.0	1.0	1.1	71.2	.012	.0024
A. P.	14.8	16.8	24.7	63.0	.9	1.0	80.8	.011	.0022
hindquarter lean, E. P.	20.0	22.7	13.4	34.2	...	...	56.9	.015	.0030
A. P.	16.7	18.9	11.2	28.6	...	...	47.5	.013	.0025
hindquarter, med. fat, A. P.	15.4	17.5	18.3	46.7	...	...	64.2	.012	.0023
hind shank, lean, E. P.	21.1	24.8	5.4	13.8	...	...	38.6	.016	.0032
A. P.	9.1	10.3	2.2	5.6	...	...	15.9	.070	.0014
hind shank, fat, E. P.	20.4	23.1	18.8	47.9	...	...	71.0	.016	.0031
A. P.	9.9	11.2	9.1	23.2	...	...	34.4	.008	.0015
juice A. P.	4.9	5.6	.6	1.5	...	...	7.1	...	....
kidney E. P.	16.6	18.8	4.8	12.2	.4	.5	31.5	.013	.0025
liver E. P.	20.4	23.1	4.5	11.5	1.7	1.9	36.5	.016	.0031
loin E. P.	19.7	22.3	12.7	32.4	...	...	54.7	.015	.0030
A. P.	17.1	19.4	11.1	28.3	...	...	47.7	.013	.0026
loin steak, cooked, E. P.	23.5	26.6	20.4	52.0	...	...	78.6	.018	.0035
neck, lean A. P.	15.1	17.1	5.9	15.0	...	...	32.1	.012	.0023
E. P.	21.4	24.3	8.4	21.4	...	...	45.7	.016	.0032
neck, med. fat E. P.	20.1	22.8	16.5	42.1	...	...	64.9	.015	.0030
A. P.	14.5	16.4	11.9	30.3	...	...	46.7	.011	.0022
plate, lean E. P.	15.6	17.7	18.8	47.9	...	...	65.6	.012	.0023
A. P.	13.0	14.7	15.5	39.5	...	...	54.2	.010	.0020
porterhouse steak E. P.	21.9	24.8	20.4	52.0	...	...	76.8	.017	.0033
A. P.	19.1	21.7	17.9	45.6	...	...	67.3	.015	.0029
rib rolls, lean A. P.	20.2	22.9	10.5	26.8	...	...	49.7	.015	.0030
ribs, lean E. P.	19.6	22.2	12.0	30.6	...	...	52.8	.015	.0029
A. P.	15.2	17.2	9.3	23.7	...	...	40.9	.012	.0023
ribs, fat E. P.	15.0	17.0	35.6	90.8	...	...	107.8	.012	.0023
A. P.	12.7	14.4	30.6	78.0	...	...	92.4	.010	.0019
roast A. P.	22.3	25.3	28.6	72.9	...	...	98.2	.017	.0033
round, lean E. P.	21.3	24.2	7.9	20.1	...	...	44.3	.016	.0032
A. P.	19.5	22.1	7.3	18.6	...	...	40.7	.015	.0029
round, free from visible fat	23.2	26.3	2.5	6.4	...	...	32.7	.018	.0035
round, med. fat A. P.	19.0	21.5	12.8	32.6	...	...	54.1	.015	.0029
round steak, lean, cooked A. P.	27.6	31.3	7.7	19.6	...	...	50.9	.021	.0041
rump, lean E. P.	20.9	23.7	13.7	34,9	...	...	58.6	.016	.0031
A. P.	19.1	21.7	11.0	28.1	...	...	49.8	.015	.0029
rump, fat E. P.	16.8	19.1	35.7	91.0	...	...	110.1	.013	.0025
A. P.	12.9	14.6	27.6	70.4	...	...	85.0	.010	.0019
shoulder and clod lean A. P.	16.4	18.6	4.4	11.2	...	...	29.8	.013	.0025
shoulder and clod med. fat A. P.	16.4	18.6	9.8	25.0	...	...	43.6	.013	.0025
side, lean E. P.	19.3	21.9	13.2	33.7	...	...	55.6	.015	.0029
A. P.	15.5	17.6	10.6	27.0	...	...	44.6	.012	.0023
sirloin steak E. P.	18.9	21.4	18.5	47.2	...	...	68.6	.014	.0028
A. P.	16.5	18.7	16.1	41.1	...	...	75.9	.013	.0025
sweet breads, canned A. P.	20.2	22 9	9.5	24.2	...	...	47.1	.015	.0030
sweet breads A. P.	16.8	19.1	12.1	30.9	...	...	50.0	.013	.0025
tenderloin A. P.	16.2	18.4	24.4	62.2	...	...	80.6	.012	.0024
tongue E. P.	18.9	21.4	9.2	23.5	...	...	44.9	.014	.0028
A. P.	14.1	16.0	6.7	17.1	...	...	33.1	.011	.0021
Beets, cooked E. P.	2 3	2.6	.1	.3	7.4	8.4	11.3	...	....
fresh E. P.	1.6	1.8	.1	.3	9.7	11.0	13.1	.030	.0006
Blackberries A. P.	1.3	1.5	1.0	2.6	10.9	12.4	16.5	.080	....
canned A. P.	.8	.9	2.1	5.4	56.4	64.0	70.3	...	....
Blackfish E. P.	18.7	21.2	1.3	3.3	...	...	24.5	.028	.0007
A. P.	7.4	8.4	.7	1.8	...	...	10.2	.011	.0003

	Protein		**Fat**	
	%	Cal. per oz.	%	Cal. per oz.
Blueberries, canned A. P.	.6	.7	.6	1.5
Bluefish E. P.	19.4	22.0	1.2	3.1
A. P.	10.0	11.3	.6	1.5
Brazil nuts E. P.	17.0	19.3	66.8	170.3
A. P.	8.6	9.8	33.7	85.9
Bread, biscuit,				
homemade A. P.	8.7	9.9	2.6	6.6
biscuit, soda A. P.	9.3	10.5	13.7	34.9
biscuit, white A. P.	8.0	9.1	1.4	3.6
brown A. P.	5.4	6.1	1.8	4.6
corn, (johnnycake) A. P.	7.9	9.0	4.7	12.0
graham A. P.	8.9	10.1	1.8	4.6
milk A. P.	9.6	10.9	1.4	3.6
pilot A. P.	11.1	12.6	5.0	12.8
rolls, French A. P.	8.5	9.6	2.5	6.4
rolls, plain A. P.	9.7	11.0	4.2	10.7
rolls, vienna A. P.	8.5	9.6	2.2	5.6
rolls, water A. P.	9.0	10.2	3.0	7.7
rye A. P.	9.0	10.2	.6	1.5
rye, (black) A. P.	9.6	10.9	.6	1.5
rye (whole) A. P.	11.9	13.5	.6	1.5
toasted	11.5	13.0	1.6	4.1
wholewheat	9.7	11.0	.9	2.3
white, homemade	9.1	10.3	1.6	4.0
white, vienna	9.4	10.7	1.2	3.1
zwieback	9.8	11.1	9.9	25.2
Brussels sprouts, canned A. P.	1.5	1.7	.1	.3
Buckwheat	10.8	12.2	2.5	6.4
flour	6.4	7.3	1.2	3.1
Buns, hot cross	7.9	9.0	4.8	12.2
Butter A. P.	1.0	1.1	85.0	216.8
Buttermilk A. P.	3.0	3.4	.5	1.3
Butternuts E. P.	27.9	31.6	61.2	156.1
A. P.	3.8	4.3	8.3	21.2
Cabbage E. P.	1.6	1.8	.3	.8
curly A. P.	4.1	4.6	.6	1.5
sprouts E. P.	4.7	5.3	1.1	2.8
Cake, chocolate layer A. P.	6.2	7.0	8.1	20.7
coffee A. P.	7.1	8.1	7.5	19.1
cup A. P.	5.9	6.7	9.0	23.0
drop A. P.	7.6	8.6	14.7	37.5
frosted A. P.	5.9	6.7	9.0	23.0
fruit A. P.	5.9	6.7	10.9	27.8
gingerbread A. P.	5.8	6.6	9.0	23.0
sponge A. P.	6.3	7.1	10.7	27.3
Cookies, molasses A. P.	7.2	8.2	8.7	22.2
Ginger snaps A. P.	6.5	7.4	8.6	21.9
Calf's-foot Jelly A. P.	4.3	4.9	...	...
Capon, cooked E. P.	27.0	30.6	11.5	29.3
Carrots, fresh E. P.	1.1	1.2	.4	1.0
Cashew nut E. P.	9.7	11.0	47.1	120.1
Cassava, dried A. P.	2.8	3.2	.5	1.3
sweet A. P.	1.1	1.2	.2	.5
Cauliflower A. P.	1.8	2.0	.5	1.3
Celery E. P.	1.1	1.2	.1	.3
soup, canned, cream of A. P.	2.1	2.4	2.8	7.1
Cerealine A. P.	9.6	10.9	1.1	2.8
Cheese, American pale A. P.	28.8	32.7	35.9	91.5
American red A. P.	29.6	33.6	38.3	97.7
cottage A. P.	20.9	23.7	1.0	2.6
full cream A. P.	25.9	29.4	33.7	85.9
cheddar A. P.	27.7	31.4	36.8	93.8
Fromage de Brie A. P.	15.9	18.0	21.0	53.6
limburger A. P.	23.0	26.1	29.4	75.0
neuchatel A. P.	18.7	21.2	27.4	69.9
pineapple A. P.	29.9	33.9	38.9	99.2
roquefort A. P.	22.6	25.6	29.5	75.2
partly skimmed milk A. P.	25.4	28.8	29.5	75.2
skimmed milk A. P.	31.5	35.7	16.4	41.8
swiss A. P.	27.6	31.3	34.9	89.0
Cherries E. P.	1.0	1.1	.8	2.0
A. P.	.9	1.0	.8	2.0
canned A. P.	1.1	1.2	.1	.3
jelly A. P.	1.1	1.2	...	...
Chestnuts, fresh E. P.	6.2	7.0	5.4	13.8
A. P.	5.2	5.9	4.5	11.5

	Protein		Fat		Carbo.		Total	Lime	Iron
	%	Cal. per oz.	%	Cal. per oz.	%	Cal. per oz.	Cal. per oz.	%	%
dried E. P.	10.7	12.1	7.0	17.9	74.2	84.1	114.1	...	....
A. P.	8.1	9.2	5.3	13.5	56.4	64.0	86.7	...	....
Chicken broilers E. P.	21.5	24.4	2.5	6.4	...	...	30.8	.016	.0032
fricasseed E. P.	17.6	20.0	11.5	29.3	2.4	2.7	52.0	.013	.0026
gumbo, canned A. P.	3.8	4.3	.9	2.3	4.7	5.3	11.9	...	....
sandwich, canned A. P.	20.8	23.6	30.0	76.5	...	...	100.1	.016	.0031
soup, canned A. P.	3.6	4.1	.1	.3	1.5	1.7	6.1	...	....
soup, homemade A. P.	10.5	11.9	.8	2.0	2.4	2.7	16.6	...	....
Chinese cabbage	1.2	1.4	...	...	1.4	1.6	3.0	...	....
Chinquapin E. P.	10.9	12.4	.7	1.8	73.8	83.7	97.9	...	....
Chocolate	12.9	14.6	48.7	124.2	30.3	34.4	173.2	.140	....
Clams, long, fresh E. P.	8.6	9.8	1.0	2.6	2.0	2.3	14.7	...	....
Clam chowder, homemade A. P.	1.8	2.0	.8	2.0	6.7	7.6	11.6	...	....
Clams, round, canned A. P.	10.5	11.9	.8	2.0	3.0	3.4	17.3	...	....
Cocoanut E. P.	5.7	6.5	50.6	129.0	27.9	31.6	167.1	.090	....
A. P.	2.9	3.3	25.9	65.9	14.3	16.2	85.4	...	....
prepared A. P.	6.3	7.1	57.4	146.4	31.5	35.7	189.2	...	....
Cod, dressed A. P.	11.1	12.6	.2	.5	...	...	13.1	.015	.0004
salt E. P.	25.4	28.8	.3	.8	...	...	29.6	.038	.0010
salt (boneless) E. P.	27.3	31.0	.3	.8	...	...	31.8	.041	.0011
whole E. P.	16.5	18.7	.4	1.0	...	...	19.7	.015	.0004
Collards E. P.	4.5	5.1	.6	1.5	6.3	7.1	13.7	...	....
Consomme, canned A. P.	2.5	2.8	...	...	.4	.5	3.3	...	....
Corn, green, sweet E. P.	3.1	3.5	1.1	2.8	19.7	22.3	28.6	.008	.0008
green, canned A. P.	2.8	3.2	1.2	3.1	19.0	21.5	27.8	...	....
soup, cream of, canned A. P.	2.5	2.8	1.9	4.8	7.8	8.8	16.4	...	....
bran	9.7	11.0	5.7	14.5	62.4	70.8	96.3	...	....
dent	10.1	11.5	5.0	12.8	70.9	80.4	104.7	...	....
flint	10.4	11.8	5.0	12.8	69.4	78.7	103.3	...	....
flour	7.1	8.1	1.3	3.3	78.4	88.9	100.3	...	....
meal, granular	9.2	10.4	1.9	4.8	75.4	85.5	100.7	.015	.0011
unbolted	8.4	9.5	4.7	12.0	74.0	83.9	105.4	...	....
oil	...	....	100.0	255.0	...	...	255.0	...	....
parched	11.5	13.0	8.4	21.4	72.3	82.0	164.0	...	....
soft	7.4	8.4	3.8	9.7	56.0	63.5	81.6	...	....
sweet, mature	11.5	13.0	7.9	20.1	67.2	76.2	109.3	...	....
syrup	...	...	...	...	83.5	94.7	94.7	...	....
Cornstarch	...	...	...	...	90.0	102.1	102.1	...	....
Cottolene	...	...	100.0	255.0	...	...	255.0	...	....
Cottonseed A. P.	19.5	22.1	19.0	48.5	24.9	28.2	98.8	...	....
meal A. P.	44.1	50.0	9.1	23.2	25.0	28.4	101.6	...	....
Crabs, hardshell, whole E. P.	16.6	18.8	2.0	5.1	1.2	1.4	25.3	...	....
canned A. P.	15.8	17.9	1.5	3.8	.7	.8	22.5	...	....
Crackers, Boston A. P.	11.0	12.5	8.5	21.7	71.1	80.6	114.8	...	....
butter A. P.	9.6	10.9	10.1	25.8	71.6	81.2	117.9	...	....
cream A. P.	9.7	11.0	12.1	30.9	69.7	79.0	120.9	...	....
egg A. P.	12.6	14.3	14.0	35.7	66.6	75.5	125.5	...	....
flatbread A. P.	14.9	16.9	.5	1.3	73.6	83.5	101.7	.027	.0015
graham A. P.	10.0	11.3	9.4	24.0	73.8	83.7	119.0	.055	.0045
oatmeal A. P.	11.8	13.4	11.1	28.3	69.0	78.2	119.9	.090	.0027
oyster A. P.	11.3	12.8	10.5	26.8	70.5	79.9	119.5	.032	.0017
saltines A. P.	10.6	12.0	12.7	32.4	68.5	77.7	122.1	.030	.0016
soda A. P.	9.8	11.1	9.1	23.2	73.1	83.9	117.2	.028	.0015
water A. P.	10.7	12.1	8.8	22.4	71.9	81.5	116.0	.030	.0016
Cranberries A. P.	.4	.5	.6	1.5	9.9	11.2	13.2	.024	.0006
Cream	2.5	2.8	18.5	47.2	4.5	5.1	55.1	.140	.0002
Cucumbers E. P.	.8	.9	.2	.5	3.1	3.5	4.9	.022	....
Currants A. P.	1.5	1.7	...	...	12.8	14.5	16.2	.050	.0005
Zante A. P.	2.4	2.7	1.7	4.3	74.2	84.1	91.1	.140	....
Dasheen	3.0	3.4	.2	.5	29.8	33.8	37.7	...	....
Dates, dried E. P.	1.9	2.2	2.5	6.4	70.6	80.1	88.7	.090	.0030
dried A. P.	2.1	2.4	2.8	7.1	78.4	88.9	98.4	.100	.0036
Doughnuts	6.7	7.6	21.0	53.6	53.1	60.2	121.4	...	....
Eels E. P.	18.6	21.1	9.1	23.2	...	...	44.3	.013	.0003
Eggs, uncooked A. P.	11.9	13.5	9.3	23.7	...	...	37.2	.093	.0030
uncooked E. P.	13.4	15.2	10.5	26.8	...	...	42.0	.093	.0030
boiled E. P.	13.2	15.0	12.0	30.6	...	...	45.6	.093	.0030
boiled whites E. P.	12.3	13.9	.2	.5	...	...	15.2	.015	.0001
boiled yolks E. P.	15.7	17.8	33.3	84.9	...	...	103.2	.200	.0085
Eggplant E. P.	1.2	1.4	.3	.8	5.1	5.8	8.0	...	....
Endive	1.0	1.1	.1	.3	3.0	3.4	4.8	.140	....
Farina	11.0	12.5	1.4	3.6	76.3	86.5	102.6	...	....
Figs, fresh E. P.	1.5	1.7	...	...	18.8	21.3	23.0	.074	.0008
dried A. P.	4.3	4.9	.3	.8	74.2	84.1	89.8	.299	.0032
stewed A. P.	1.2	1.4	.3	.8	40.9	46.4	48.6	.080	.0009

	Protein		Fat		C
	%	Cal. per oz.	%	Cal. per oz.	%
Filbert E. P.	15.6	17.7	65.3	166.5	13
A. P.	7.5	8.5	31.3	79.8	6
Flaxseed	22.6	25.6	33.7	85.9	23.
Flounder A. P.	5.4	6.1	.3	.8	..
E. P.	14.2	16.1	.6	1.5	..
Flour, gluten, pure	81.2	92.1	.6	1.5	16.
gluten 40%	42.5	48.2	1.0	2.6	42.
wheat entire	13.8	15.6	1.9	4.8	71.
wheat, straight grade	10.8	12.2	1.1	2.8	74.
wheat, average high and medium	11.4	12.9	1.0	2.3	75.
Fowls E. P.	19.3	21.9	16.3	41.6	..
A. P.	13.7	15.5	12.3	31.4	..
Frankforts, sausage A. P.	19.6	22.2	18.6	47.4	1.
Frog's legs E. P.	15.5	17.6	.2	.5	..
Garlic	6.8	7.7	.1	.3	27
Gelatin	91.4	103.6	.1	.3	..
Goose, young E. P.	16.3	18.5	36.2	92.3	..
Grapes E. P.	1.3	1.5	1.6	4.1	19
A. P.	1.0	1.1	1.2	3.1	14
butter A. P.	1.2	1.4	.1	.3	58
ground A. P.	2.8	3.2	.6	1.5	60
Greens, beet, cooked	2.2	2.5	3.4	8.7	3.
dandelion A. P.	2.4	2.7	1.0	2.6	10
turnip salad A. P.	4.2	4.8	.6	1.5	6
Haddock E. P.	17.2	19.5	.3	.8	..
A. P.	8.4	9.5	.2	.5	..
Halibut A. P.	15.3	17.4	4.4	11.2	..
steak E. P.	18.6	21.1	5.2	13.3	..
Ham, fresh, lean E. P.	25.0	28.4	14.4	36.7	..
A. P.	24.8	28.1	14.2	36.2	..
fresh, med. E. P.	15.3	17.4	28.9	73.7	..
A. P.	13.5	15.3	25.9	66.0	..
smoked, lean E. P.	19.8	22.5	20.8	53.0	..
A. P.	17.5	19.8	18.5	47.2	..
Hazelnut	8.0	9.1	28.5	72.7	11.
Herring E. P.	19.5	22.1	7.1	18.1	..
A. P.	11.2	12.7	3.9	9.9	..
smoked E. P.	36.9	41.8	15.8	40.3	..
A. P.	20.5	23.2	8.8	22.4	..
Hickory E. P.	15.4	17.5	67.4	171.9	11
A. P.	5.8	6.6	25.5	65.0	4
Hominy	8.3	9.4	.6	1.5	79
cooked	2.2	2.5	.2	.5	17.
pearled	7.8	8.8	3.3	8.4	76
Honey A. P.	.4	.5	...	...	81
Huckleberries E. P.	.6	.7	.6	1.5	16.
Julienne, canned A. P.	2.7	3.1	...	...	
Kafir corn A. P.	6.6	7.5	3.8	9.7	70
Kaoliang grain A. P.	10.5	11.9	4.3	11.0	71.
Kohl-rabi E. P.	2.0	2.3	.1	.3	5.
Koumiss	2.8	3.2	2.1	5.4	5.
Lamb breast E. P.	19.1	21.7	23.6	60.2	..
A. P.	15.4	17.5	19.1	48.7	..
chops, broiled E. P.	21.7	24.6	29.9	76.2	..
fore quarter E. P.	18.3	20.8	25.8	65.8	..
A. P.	14.9	16.9	21.0	53.6	..
hindquarter E. P.	19.6	22.2	19.1	48.7	..
A. P.	16.5	18.7	16.1	41.1	..
leg roast	19.7	22.3	12.7	32.4	..
side E. P.	17.6	20.0	23.1	58.9	..
A. P.	14.1	16.0	18.7	47.7	..
loin E. P.	18.7	21.2	28.3	72.2	..
Lard, refined	...	...	100.0	255.0	..
Leeks E. P.	1.2	1.4	.5	1.3	5.
Lemons E. P.	1.0	1.1	.7	1.8	8.
A. P.	.7	.8	.5	1.3	5.
juice	...	...	...	...	9.
Lentils A. P.	25.7	29.1	1.0	2.6	59.
Lettuce E. P.	1.2	1.4	.3	.8	2.
A. P.	1.0	1.1	.2	.5	2.
Litchi nut E. P.	2.9	3.3	2.1	5.4	77.
A. P.	1.7	1.9	.1	.3	45.
Linseed meal A. P.	36.9	41.8	2.9	7.4	36.
Liver, beef E. P.	20.4	23.1	4.5	11.5	1.
veal E. P.	19.0	21.5	5.3	13.5	..
Lobster, fresh E. P.	16.4	18.6	1.8	4.6	
whole A. P.	5.9	6.7	.7	1.8	
canned A. P.	18.1	20.5	1.1	2.8	

	Protein		Fat		Carbo.		Total	Lime	Iron
	%	Cal. per oz.	%	Cal. per oz.	%	Cal. per oz.	Cal. per oz.	%	%
Loganberry juice, com.	.2	.2	...	...	30.9	35.0	35.2	...	....
Macaroni	13.4	15.2	.9	2.3	74.1	84.0	101.5	...	....
cooked	3.0	3.4	1.5	3.8	15.8	17.9	25.1	...	....
Macaroons	6.5	7.4	15.2	38.8	65.2	73.9	120.1	...	....
Mackerel A. P.	10.2	11.6	4.2	10.7	...	...	22.3	.015	.0004
E. P.	18.7	21.2	7.1	18.1	...	...	39.3	.028	.0007
salt E. P.	21.1	23.9	22.6	57.6	...	...	81.5	.032	.0008
salt A. P.	16.3	18.5	17.4	44.4	...	...	62.9	.025	.0007
Malt	18.0	20.4	3.7	9.4	60.6	68.7	98.5	.060	.0040
Mango E. P.	.6	.7	...	...	10.0	11.3	12.0	.030	....
Marmalade (orange peel)	.6	.7	.1	.3	84.5	95.8	96.8	...	....
Meat stew, homemade A. P.	4.6	5.2	4.3	11.0	5.5	6.2	22.4	...	....
Milk	3.3	3.7	4.0	10.2	5.0	5.7	19.6	.168	.00024
condensed, sweetened	8.8	10.0	8.3	21.2	54.1	61.3	92.5	.454	.0065
condensed, unsweetened	9.6	10.9	9.3	23.7	11.2	12.7	47.3	.504	.0072
skimmed	3.4	3.9	.3	.8	5.1	5.8	10.5	.170	.0027
skimmed, dried	36.6	41.5	4.2	10.7	25.8	29.3	81.5	1.700	.0270
ewe's	6.5	7.4	6.9	17.6	4.9	5.6	30.6	...	....
mare's	2.0	2.3	1.1	2.8	5.9	6.7	11.8	...	....
sow's	5.9	6.7	6.7	17.1	5.4	5.1	29.9	...	....
Millet	8.3	9.4	2.8	7.1	44.3	50.2	66.7	...	....
Mincemeat, commercial	6.7	7.6	1.4	3.6	60.2	68.3	79.5	...	....
Molasses	2.4	2.7	...	...	69.3	78.6	81.3	.9	.0073
Mock turtle, canned E. P.	5.2	5.9	.9	2.3	2.8	3.2	14.5	...	....
Mulberry	.3	.3	...	...	14.4	16.3	16.6	...	....
Mullet, whole E. P.	19.5	22.1	4.6	11.7	...	...	33.8	.029	.0008
Mulligatawny, canned A. P.	3.7	4.2	.1	.3	5.7	6.5	11.0	...	....
Mushrooms A. P.	3.5	4.0	.4	1.0	6.8	7.7	12.7	.024	....
Muskmelon E. P.	.6	.7	...	...	9.3	10.5	11.2	.024	.0003
A. P.	.3	.3	...	...	4.6	5.2	5.5	...	....
Mussels, fresh E. P.	8.7	9.9	1.1	2.8	4.1	4.6	17.3	...	....
Mutton, fore quarter E. P.	15.6	17.7	30.9	78.8	...	...	96.5	.016	.0023
A. P.	12.3	13.9	24.5	62.5	...	...	76.4	.009	.0018
hind quarter E. P.	16.7	18.9	28.1	71.7	...	...	90.6	.013	.0025
A. P.	13.8	15.6	23.2	59.2	...	...	74.8	.011	.0021
leg, hind lean E. P.	19.8	22.3	12.4	31.6	...	...	53.9	.015	.0030
leg A. P.	16.5	18.7	10.3	26.3	...	...	45.0	.013	.0025
cooked, leg roast	25.0	28.3	22.6	57.6	...	...	85.9	.019	.0038
loin E. P.	16.0	18.1	33.1	84.4	.8	.9	103.4	.012	.0024
side A. P.	13.0	14.7	24.0	61.2	...	...	75.9	.010	.0020
E. P.	16.2	18.4	29.8	76.0	...	...	94.4	.012	.0024
Nectarines E. P.	.6	.7	...	...	15.9	18.0	18.7	...	....
A. P.	.6	.7	...	...	14.8	16.8	17.5	...	....
Oats	12.4	14.1	4.4	11.2	59.6	67.6	92.9	...	....
rolled	16.7	18.9	7.3	18.6	66.2	75.1	112.6	.130	.0036
Oatmeal	16.1	18.3	7.2	18.4	67.5	76.5	113.2	.130	.0036
boiled	2.8	3.2	.5	1.3	11.5	13.0	17.5	.022	.0006
gruel	1.2	1.4	.4	1.0	6.3	7.1	9.5	.010	.0003
water	.7	.8	.1	.3	2.9	3.3	4.4	.006	.0002
Okra E. P.	1.6	1.8	.2	.5	7.4	8.4	10.7	...	....
A. P.	1.4	1.6	.2	.5	6.5	7.4	9.5	...	....
tomato canned A. P.	1.1	1.2	.3	.8	5.2	5.9	7.9	...	....
canned A. P.	.7	.8	.1	.3	3.6	4.1	5.2	...	....
Oleomargarine A. P.	1.2	1.4	83.0	211.7	...	...	213.1	...	....
Olives, green E. P.	1.1	1.2	27.6	70.4	11.6	13.2	84.8	.170	.0029
A. P.	.8	.9	20.2	51.5	8.5	9.6	62.0	...	....
ripe A. P.	1.4	1.6	21.0	53.6	3.5	4.0	59.2	...	....
E. P.	1.7	1.9	25.9	66.0	4.3	4.9	72.8	...	....
Onions A. P.	1.4	1.6	.3	.8	8.9	10.1	12.5	...	....
E. P.	1.6	1.8	.3	.8	9.9	11.2	13.8	.060	.0005
cooked A. P.	1.2	1.4	1.8	4.6	4.9	5.6	11.6	.045	.0004
green E. P.	1.0	1.1	.1	.3	11.2	12.6	14.0	.040	.0003
Oranges E. P.	.8	.9	.2	.5	11.6	13.2	14.6	.060	.0003
A. P.	.6	.7	.1	.3	8.5	9.6	10.6	...	....
Oxtail soup, canned A. P.	3.8	4.3	.5	1.3	4.2	4.8	10.4	...	....
Oysters. fresh E. P.	6.2	7.0	1.2	3.0	3.7	4.2	14.2	...	....
canned A. P.	8.8	10.0	2.4	6.1	3.9	4.4	20.5	...	....
in shell A. P.	1.2	1.4	.2	.5	.7	.8	2.7	...	....
Papaw	5.2	5.9	.9	2.3	6.8	7.7	15.9	...	....
Paradise nut E. P.	22.2	25.2	62.6	159.6	10.2	11.6	196.4	...	....
Parsnips E. P.	1.6	1.8	.5	1.3	13.5	15.3	18.4	.090	....
A. P.	1.3	1.5	.4	1.0	10.8	12.2	14.7	...	....
Peas, dried A. P.	24.6	27.9	1.0	2.6	62.0	70.3	100.8	.140	.0056
green E. P.	7.0	7.9	.5	1.3	16.9	19.2	20.5	.040	.0016
green, cooked E. P.	6.7	7.6	3.4	8.7	14.6	16.6	32.9	...	....
green, sugar E. P.	3.4	3.9	.4	1.0	13.7	15.5	20.4	...	....
cowpeas, dry A. P.	21.4	24.3	1.4	3.6	60.8	68.9	96.8	.180	....
green, canned A. P.	3.6	4.1	.2	.5	9.8	11.1	15.7	...	....

	Protein		Fat		Carbo.		Total	Lime
	%	Cal. per oz.	%	Cal. per oz.	%	Cal. per oz.	Cal. per oz.	%
Pea meal	23.8	27.0	1.4	3.6	55.7	63.2	93.8	.140
soup, canned A. P.	3.6	4.1	.7	1.8	7.6	8.6	14.5	...
soup, cream of green, canned A. P.	2.6	2.9	2.6	6.9	5.7	6.5	16.3	...
Peaches E. P.	.7	.8	.1	.3	9.4	10.7	11.8	.010
A. P.	.5	.6	.1	.3	7.7	8.7	9.6	...
canned E. P.	.7	.8	.1	.3	10.8	12.2	13.3	...
Peanuts E. P.	25.8	29.3	38.6	98.4	24.4	27.7	155.4	.100
A. P.	19.5	22.1	29.1	74.2	18.5	21.0	117.3	...
cake (whole nuts)	47.6	54.0	8.0	20.4	23.7	26.9	101.3	...
Pears E. P.	.6	.7	.5	1.3	14.1	16.0	18.0	.021
A. P.	.5	.6	.4	1.0	12.7	14.4	16.0	...
canned E. P.	.3	.3	.3	.8	18.0	20.4	21.5	...
dried A. P.	2.8	3.2	2.2	5.6	72.9	82.7	.91.5	...
Pecans, unpolished E. P.	9.6	10.9	70.5	179.8	15.3	17.4	208.1	...
A. P.	5.1	5.8	37.9	96.6	8.2	9.3	111.7	...
Persimmons E. P.	.8	.9	.7	1.8	31.5	35.7	38.4	.030
Pickerel, pike (whole) E. P.	18.7	21.2	.5	1.3	...	...	22.5	.028
Pickles, cucumber A. P.	.5	.6	.3	.8	2.7	3.1	4.5	...
Pie, apple A. P.	3.1	3.5	9.8	25.0	42.8	48.5	77.0	...
custard A. P.	4.2	4.8	6.3	16.1	26.1	29.6	50.5	...
mince A. P.	5.8	6.6	12.3	31.5	38.1	43.2	81.3	.040
Pineapple E. P.	.4	.5	.3	.8	9.7	11.0	12.3	.020
canned E. P.	.4	.5	.7	1.8	36.4	41.3	43.6	...
Pine nuts								
(Pignolias) E. P.	33.9	38.4	49.4	126.0	6.9	7.8	172.2	...
(Pinon) E. P.	14.6	16.6	61.9	157.9	17.3	19.6	194.1	...
A. P.	8.7	9.9	36.8	93.8	10.2	11.6	115.3	...
Pistachios E. P.	22.3	25.3	54.0	137.7	16.3	18.5	181.5	...
Plums E. P.	1.0	1.1	...	...	20.1	22.8	23.9	.025
A. P.	.9	1.0	...	...	19.1	21.7	22.7	...
Pomegranates E. P.	1.5	1.7	1.6	4.1	19.5	22.1	27.9	...
Pompano (whole) E. P.	18.8	21.3	7.5	19.1	...	...	40.4	.028
Pop corn	10.7	12.1	5.0	12.8	78.7	89.2	114.1	...
Pork chops, med. E. P.	16.6	18.8	30.1	76.8	...	...	95.6	.013
A. P.	13.4	15.2	24.2	61.7	...	...	76.9	.010
chuck ribs and shoulder E. P.	17.3	19.6	31.1	79.3	...	...	98.9	.013
A. P.	14.1	16.0	25.5	65.0	...	...	81.0	.011
fat, salt A. P.	1.9	2.2	86.2	219.8	...	...	222.0	.002
loin chops, fat E. P.	14.5	16.4	44.4	113.2	...	...	129.6	.011
side E. P.	9.1	10.3	55.3	141.0	...	...	151.3	.007
A. P.	8.0	9.1	49.0	125.0	...	...	134.1	.006
tenderloin A. P.	18.9	21.4	13.0	33.2	...	...	54.6	.014
salt, lean ends E. P.	8.4	9.5	67.1	171.1	...	...	180.6	.007
sausage, bologna E. P.	18.7	21.2	17.6	44.9	...	...	66.1	.014
steak, cooked A. P.	19.9	22.6	45.4	115.8	...	...	138.4	.015
Potatoes, raw E. P.	2.2	2.5	.1	.3	18.4	20.9	23.7	.016
A. P.	1.8	2.0	.1	.3	14.7	16.7	19.0	...
evaporated A. P.	8.5	9.6	.4	1.0	80.9	91.7	102.3	.064
cooked, boiled A. P.	2.5	2.8	.1	.3	20.9	23.7	26.8	...
cooked, chips A. P.	6.8	7.7	39.8	101.5	46.7	53.0	162.2	...
sweet, raw E. P.	1.8	2.0	.7	1.8	27.4	31.1	34.9	.025
sweet, canned A. P.	1.9	2.2	.4	1.0	41.4	46.9	50.1	...
sweet, cooked A. P.	3.0	3.4	2.1	5.4	42.1	47.7	56.5	...
chips A. P.	6.8	7.7	39.8	101.5	46.7	53.0	162.2	...
flakes dried	7.1	8.1	.3	.8	73.6	83.5	92.4	...
flour	2.7	3.1	.8	2.0	81.3	92.2	97.3	...
Prunes E. P.	.9	1.0	...	...	18.9	21.4	22.4	...
A. P.	.7	.8	...	...	17.4	19.7	20.5	...
dried E. P.	2.1	2.4	...	...	73.3	83.1	85.5	.060
dried A. P.	1.8	2.0	...	...	62.2	70.5	72.5	...
Pudding, Indian meal A. P.	5.5	6.2	4.8	12.2	27.5	31.2	49.6	...
rice custard A. P.	4.0	4.5	4.6	11.7	31.4	35.6	51.8	...
Pumpkins E. P.	1.0	1.1	.1	.3	5.2	5.9	7.3	.030
canned A. P.	.8	.9	.2	.5	6.7	7.6	9.0	...
Quail, canned A. P.	21.8	24.7	8.0	20.4	1.7	1.9	47.0	.017
Quinoa flour	19.0	21.5	5.0	12.8	60.0	68.0	102.3	...
Radishes E. P.	1.3	1.5	.1	.3	5.8	6.6	8.4	.051
A. P.	2.3	2.6	3.0	7.7	68.5	77.7	88.0	...
Raisins E. P.	2.6	2.9	3.3	8.4	76.1	86.3	97.6	.080
Raspberries, black E. P.	1.7	1.9	1.0	2.6	12.6	14.3	18.8	...
red A. P.	1.0	1.1	...	...	12.6	14.3	15.4	.070
dried A. P.	7.3	8.3	1.8	4.6	80.2	90.9	103.8	...
Raspberry juice, sweetened	.5	.6	...	...	49.9	56.6	57.2	.030
Rhubarb E. P.	.6	.7	.7	1.8	3.6	4.1	6.6	.060
Rice	8.0	9.1	.3	.8	79.0	89.6	99.5	.012
boiled	2.8	3.2	.1	.3	24.4	27.7	31.2	.004
flaked	7.9	9.0	.4	1.0	81.9	92.9	102.9	.012

	Protein		Fat		Carbo.		Total	Lime	Iron
	%	Cal. per oz.	%	Cal. per oz.	%	Cal. per oz.	Cal. per oz.	%	%
flour	8.6	9.8	6.1	15.6	68.0	77.1	102.5	.013	.0009
polish	11.9	13.5	9.1	23.2	62.3	70.6	107.3	.012	.0009
Ruta-bagas E. P.	1.3	1.5	.2	.5	8.5	9.6	11.6	.100	....
Rye	11.8	13.4	1.8	4.6	73.2	83.0	101.0	.070	.0040
bran	12.2	13.8	2.8	7.1	56.6	64.2	85.1	.250	.0140
flour	6.8	7.7	.9	2.3	78.7	89.2	99.2	.042	.0024
meal	13.6	15.4	2.0	5.1	71.5	81.1	101.6	.070	.0040
Salmon, dressed A. P.	13.8	15.6	8.1	20.7	...	...	36.3	.021	.0006
whole A. P.	15.3	17.4	8.9	22.7	...	...	40.1	.023	.0006
whole E. P.	22.0	24.9	12.8	32.6	...	...	57.5	.033	.0009
Sandwich, egg A. P.	9.6	10.9	12.7	32.4	34.5	39.1	82.4	...	....
chicken A. P.	12.3	13.9	5.4	13.8	32.1	36.4	64.1	...	....
Sardines canned E. P.	23.0	26.1	19.7	50.2	...	...	76.3	.035	.0009
Sauerkraut A. P.	1.7	1.9	.5	1.3	3.8	4.3	7.5	...	....
Sausage, farmer E. P.	29.0	32.9	42.0	107.0	...	...	139.9	.022	.0044
A. P.	27.9	31.6	40.4	103.0	...	...	134.6	.021	.0042
Seakale	1.4	1.6	.4	1.0	3.8	4.3	6.9	...	....
Shad, whole E. P.	18.8	21.3	9.5	24.2	...	...	45.5	.028	.0008
A. P.	9.4	10.7	4.8	12.2	...	...	22.9	.014	.0004
roe	20.9	23.7	3.8	9.7	2.6	2.9	36.3	...	....
Shredded wheat A. P.	10.5	11.9	1.4	3.6	77.9	88.3	103.8	.061	.0053
Shrimp, canned A. P.	25.4	28.8	1.0	2.6	.2	.2	31.6	...	....
Soy beans A. P.	39.5	44.9	18.5	47.3	6.5	25.7	7.4	99.6	....
Soy bean milk A. P.	4.2	4.8	1.9	4.8	...	...	9.6	...	....
meal (fat extracted)	41.4	46.9	7.4	18.9	28.7	32.5	98.3	...	....
Spaghetti A. P.	12.1	13.7	.4	1.0	76.3	86.5	101.2	...	....
Spinach, fresh A. P.	2.1	2.4	.3	.8	3.2	3.6	6.8	.090	.0032
cooked A. P.	2.1	2.4	4.1	10.5	2.6	2.9	15.8	.090	.0032
Squash E. P.	1.4	1.6	.5	1.3	9.0	10.2	13.1	.020	.0008
A. P.	.7	.8	.2	.5	4.5	5.1	6.4	...	....
canned A. P.	.9	1.0	.5	1.3	10.5	11.9	14.2	...	....
Starch, arrowroot	...	...	...	...	97.5	110.6	110.6	...	....
cornstarch	...	...	...	...	90.0	102.1	102.1	...	....
manioca	.5	.6	.1	.3	88.8	100.7	101.6	...	....
sago	9.0	10.2	.4	1.0	78.1	88.6	99.8	...	....
tapioca	.4	.5	.1	.3	88.0	99.8	100.6	...	....
Strawberries, E. P.	1.0	1.1	.6	1.5	7.4	8.4	11.0	.05	.0009
A. P.	.9	1.0	.6	1.5	7.0	7.9	10.4	...	....
stewed	.7	.8	...	...	24.0	27.2	28.0	...	....
Succotash canned A. P.	3.6	4.1	1.0	2.6	18.6	21.1	27.8	...	....
Sugar, brown A. P.	...	...	...	...	95.0	107.7	107.7	...	....
granulated A. P.	...	...	...	...	100.0	113.4	113.4	...	....
maple A. P.	...	...	...	...	82.8	93.9	93.9	...	....
meltose A. P.	1.8	2.0	.1	.3	89.9	101.9	104.2	.262	.0214
Sunflower seed, hulless A. P.	27.7	31.4	41.4	105.6	16.3	18.5	155.5	...	....
seed cake A. P.	34.8	39.5	18.3	46.7	21.8	24.7	110.9	...	....
Syrup, maple A. P.	...	...	...	...	71.4	81.0	81.0	...	....
Tallow, refined A. P.	...	...	100.0	255.0	...	...	255.0	...	....
Taro A. P.	1.8	2.0	.2	.5	23.2	26.3	28.8	...	....
Terrapin E. P.	21.2	24.0	3.5	8.9	...	...	32.9	...	....
To fu	10.2	12.6	3.7	9.0	...	...	21.6	...	....
Tomatoes, fresh A. P.	.9	1.0	.4	1.0	3.9	4.4	6.4	.020	.0004
canned A. P.	1.2	1.4	.2	.5	4.0	4.5	6.4	.020	.0004
dried A. P.	12.9	14.6	8.1	20.7	62.3	70.6	105.9	.286	.0057
soup, canned A. P.	1.8	2.0	1.1	2.8	5.6	6.4	11.2	...	....
Trout, brook, whole E. P.	19.2	21.8	2.1	5.4	...	...	27.2	.029	.0008
salmon E. P.	17.8	20.2	10.3	26.3	...	...	46.5	.027	.0007
Turkey E. P.	21.1	23.9	22.9	58.4	...	...	82.3	.016	.0032
A. P.	16.1	18.3	18.4	46.9	...	...	65.2	.012	.0024
sandwich, canned	20.7	23.5	29.2	74.5	...	...	98.0	.016	.0031
roast, stuffed E. P.	17.1	19.4	10.8	27.5	5.5	6.2	53.1	.013	.0026
Turnips E. P.	1.3	1.5	.2	.5	8.1	9.2	11.2	.089	.0005
A. P.	.9	1.0	.1	.3	5.7	6.5	7.8	...	....
Turtle, green, canned A. P.	6.1	6.9	1.9	4.8	3.9	4.4	27.3	...	....
canned E. P.	19.8	22.5	.5	1.3	...	...	23.8	...	....
Vegetable soup canned	2.9	3.3	...	...	.5	.6	3.9	...	....
Veal, breast E. P.	20.3	23.0	11.0	28.1	...	...	51.1	.015	.0030
A. P.	15.3	17.4	8.6	21.9	...	...	39.3	.012	.0023
chuck, lean E. P.	20.6	23.4	1.9	4.8	...	...	28.2	.016	.0031
med. fat E. P.	19.7	22.3	6.5	16.6	...	...	38.9	.015	.0030
cutlets E. P.	20.3	23.0	7.7	19.6	...	...	42.6	.015	.0030
A. P.	20.1	22.8	7.5	19.1	...	...	41.9	.015	.0030
forequarter E. P.	20.0	22.7	8.0	20.4	...	...	43.1	.015	.0030
A. P.	15.1	17.1	6.0	15.3	...	...	32.4	.012	.0023
hind quarter E. P.	20.7	23.5	8.3	21.2	...	...	44.7	.016	.0031
A. P.	16.2	18.4	6.6	16.8	...	...	35.2	.016	.0023
side E. P.	20.2	22.9	8.1	20.7	...	...	43.6	.015	.0030
side A. P.	15.6	17.7	6.3	16.1	...	...	33.8	.016	.0023
loin med. fat E. P.	19.9	22.6	10.8	27.5	...	...	50.1	.015	.0030

	Protein		Fat	
	%	Cal. per oz.	%	Cal. per oz.
Vermicelli	10.9	12.4	2.0	5.1
Walnuts, California E. P.	18.4	20.9	64.4	164.2
A. P.	4.9	5.6	17.3	44.1
Calif. black E. P.	27.6	31.3	56.3	143.6
A. P.	7.2	8.2	14.6	37.2
Calif. soft shell E. P.	16.6	18.8	63.4	161.7
A. P.	6.9	7.8	26.6	67.8
Water chestnut	1.5	1.7	.2	.4
Watermelon E. P.	.4	.5	.2	.5
A. P.	.2	.2	.1	.3
Wheat bran	12.5	14.2	3.0	7.7
bran, sterilized	20.0	22.9	4.5	11.6
flaked	13.4	15.2	1.4	3.6
germs	10.5	11.9	2.0	5.1
shredded	10.5	11.9	1.4	3.6
winter	11.7	13.3	2.0	5.1
spring	12.5	14.2	2.2	5.6
durum	14.1	16.0	2.5	6.4
polish	20.3	23.0	1.7	4.3
middlings, standard short	17.4	19.7	4.9	12.5
flour, California	7.9	9.0	1.4	3.6
gluten	14.2	16.1	1.8	4.6
graham	13.3	15.1	2.2	5.6
baker's grade	13.3	15.1	1.5	3.8
straight grade, spring	10.8	12.4	1.1	2.8
winter	12.3	13.9	1.1	2.8
low grade	14.0	15.9	1.9	4.8
cracked and crushed	11.1	12.6	1.7	4.3
Whey	.8	.9	.3	.8
Whitefish, whole E. P.	22.9	26.0	6.5	16.6
A. P.	10.6	12.0	3.0	7.7
Whortleberries A. P.	.7	.8	3.0	7.7
Wienerwurst A. P.	28.0	31.8	22.1	56.4
Yautia	2.2	2.5	.2	.5

Appendix

DIGESTIBILITY OF FOODSTUFFS AND TIME REQUIRED FOR THEIR DIGESTION

Both the digestibility of foodstuffs and the time required for their digestion depend much upon the condition and the manner in which they are eaten and the quantity of material taken at one time. The amount of material absorbed from the digested food depends largely upon the amount of cellulose or roughage present. Indigestible material hastens the foodstuffs along the alimentary tract and thus lessens the amount absorbed. The amount of food material lost in this manner, however, is of little consequence compared with the importance of the prompt dismissal of unusable food residues, for the accomplishment of which a considerable amount of roughage is highly essential. Even in the case of foods which contain considerable cellulose, such as legumes, nuts and some fruits, digestion and absorption are satisfactorily performed provided the foodstuffs are thoroughly chewed or well comminuted before eaten.

The following table shows the degree of digestibility of various foodstuffs as determined by various authorities (Tibbles):—

Source of Nutriment	Protein		Carbohydrate		Fat	
	Digested Per Cent.	Calories Per Ounce	Digested Per Cent.	Calories Per Ounce	Digested Per Cent.	Calories Per Ounce
Foods in mixed diet	92	114.00	97	114	95	253.0
Animal foods in mixed diet ..	97	121.00	98	108	95	253.0
Vegetable foods in mixed diet ..	84	90.00	97	114	90	237.5
Meat and fish	97	121.25	98	108	95	252.5
Eggs	97	123.75	98	108	95	255.6
Milk, cheese and other dairy products	97	121.25	98	108	95	250.0
Cereals and sugar	85	109.37	98	116	90	237.5
Legumes, dried ..	78	97.00	97	115	90	237.5
Fruits	85	95.00	90	102	90	237.5
Vegetables	83	88.00	95	113	90	237.5

DIGESTIBILITY OF FRUITS AND NUTS

The following table (Tibbles) shows the digestibility of fruits and nuts in various combinations:—

	Food digested, Per cent.		
	Protein	Fat	Carbohydrate
Olives, grapes, tomatoes	44.43	67.76	95.84
Brazil nuts, grapes	84.17	91.20	95.06
Brazil nuts, wheat flakes	85.44	84.32	97.45
Walnuts, grapes, wheat flakes	79.76	89.48	97.18

	Food
	Protein
Peanuts, persimmons, wheat flakes and milk	**86.80**
Walnuts, pears, milk and wheat flakes	**84.10**
Cocoanut and pears	**75.12**
Walnuts, figs, apples	**70.79**
Peanuts, dates, apples	**78.14**
Pecans, dates, apples	**76.16**
Walnuts, raisins, apples	**80.70**

DR. BEAUMONT'S DIGESTIO

The following table presents the principal fac in his experiments upon St. Martin in relation to th gastric digestion of various foodstuffs named:—

Rice ....
Sago ....
Tapioca ....
Barley ....
Milk ....
" ....
Gelatine ....
Tripe, soused ....
Brains, animal ....
Venison, steak ....
Spinal marrow, animal ....
Turkey, domesticated ....
" " ....
Goose, wild ....
Pig, sucking ....
Liver, beef's, fresh ....
Lamb, fresh ....
Chicken, full grown ....
Eggs, fresh ....
" " ....
" " ....
" " ....
" " ....
" whipped ....
Custard ....
Codfish, cured dry ....
Trout, salmon, fresh ....
" " " ....
Bass, striped " ....
Flounder " ....
Catfish " ....
Salmon, salted ....
Oysters, fresh ....
" " ....
" " ....
Beef, fresh, lean, rare ....
" steak ....
" with salt only ....
" ....
" old, hard, salted ....
Pork, steak ....
" fat and lean ....
" recently salted ....
" " " ....
" " " ....
" " " ....
" " " ....

		h. m.
Mutton, fresh	roasted	3:15
" "	boiled	3:00
Veal, fresh	broiled	4:00
" "	fried	4:30
Fowls, domestic	boiled	4:00
" "	roasted	4:00
Ducks, domesticated	"	4:00
" wild	"	4:30
Suet, beef, fresh	boiled	5:30
" mutton	"	4:30
Butter,	melted	3:30
Cheese, old, strong	raw	3:30
Soup, beef, veg. and br'd.	boiled	4:00
" marrow bones	"	4:15
" bean	"	3:00
" barley	"	1:30
" mutton	"	3:30
Green corn and beans	"	3:45
Chicken soup	"	3:00
Oyster soup	"	3:30
Hash, meat and veg.	warmed	2:30
Sausage, fresh	broiled	3:20
Heart, animal	fried	4:00
Tendon	boiled	5:30
Cartilage	"	4:15
Aponeurosis	"	3:00
Beans, pod	"	2:30
Bread, wheat, fresh	baked	3:30
" corn	"	3:15
Cake "	"	3:00
" sponge	"	2:30
Dumpling, apple	boiled	3:00
Apples, sour, hard	raw	2:50
" " mellow	"	2:00
" sweet, "	"	1:30
Parsnips	boiled	2:30
Carrot, orange	"	3:15
Beets	"	3:45
Turnips, flat	"	3:30
Potatoes, Irish	"	3:30
" "	baked	2:30
Cabbage, head	raw	2:30
"	boiled	4:30

THE TIME REQUIRED FOR GASTRIC DIGESTION

Within recent years numerous observers have renewed the study of the time required for gastric digestion by the aid of modern methods of research. The following table (Tibbles) shows the results of the most recent and reliable investigations:—

Kind of Food	Quantity of Food	Time in which the Food left the Stomach
Beef	3½ ounces of raw beef	2 hours
	" of half-boiled beef	2½ "
	" of boiled beef	3 "
	" of half-roasted beef	3 "
	" of roasted beef	4 "
Mutton	3½ " of raw mutton	2 "
	" of half-boiled mutton	2½ "
	" of boiled mutton	3 "

Kind of Food	Quantity of Food
Mutton	3½ ounces of half-roasted m
	" of roasted mutto
Veal	3½ " of raw veal
	" of boiled veal
	" of roasted veal
Pork	3½ " of raw pork
	" of boiled pork
	" of roast pork
Sweetbread	9½ " of cooked sweetb
Chicken	8¼ " of cooked chicken
Ham	6 " of boiled ham
Tongue	9 " of smoked tongue
Goose	9 " of roast goose
Fish	7½ " of salt fish
	7½ " of fresh fish
Oysters	10 raw oysters
Eggs	2 lightly boiled eggs
	2 raw eggs
	2 poached eggs + 5 grammes
	2 hard-boiled eggs
	2 eggs in omelet
Milk	½ pint of raw milk
	" of boiled milk
	1 " of raw milk
	1 " of skimmed milk
	1 " of sour milk
	1 " of boiled milk
Bread	2½ ounces of white bread
	5⅓ " of white bread
	5⅓ " of brown bread
Rice	5½ ounces of boiled rice
Barley	2½ " of boiled barley
Tapioca	1⅔ " " tapioca
Lentils	5⅓ " " lentils,
Dried peas	7½ " " peas or
French beans	7½ " " beans
Potatoes	5⅓ " .. potato
Carrots	5⅓ " " carrots
Cabbage	5⅓ " " cabbage
Cauliflower	5⅓ " " cauliflow
Spinach	5⅓ " " spinach
Radishes	5⅓ " of raw radishes
Apples	5⅓ " of ripe apples
	5⅓ " of unripe "
Cherries	3½ " of ripe cherries

In the use of the above table, it should be
given relate wholly to gastric digestion. The ti
digestion and absorption of the average meal ar
indigestible residues into the colon, is eight ho
foodstuffs and the time required for digestion
much less importance than formerly supposed.
wholesome foods are digested the most quickl
shall be sufficient in amount and properly balan
as to maintain a normal non-putrefactive flora
matters of primary consequence.

FOOD REQUIREMENT

The amount of food needed differs according to the age, the size, and the amount of muscular activity.

Small animals require more food in proportion to their size than do large. Some insects eat all the time. Small birds consume each day an extraordinary amount of food. Infants and children need much more food in proportion to their size than do adults.

For persons of average weight, the food requirement may be determined by multiplying the body weight in pounds by the number of calories which careful laboratory research has shown to be requisite, as follows:

Age	Calories per Pound	Age	Calories per Pound
Birth to 1 month	30	6 years	34-35
2 months	40	7 "	32-34
3 "	41	8 -9 "	30-35
4 -6 "	43	10-12 "	28-32
7 -9 "	40	12-13 "	25-30
1 -2 years	40	14-17 "	20-25
3 -4 "	37-40	Adults	16-20
5 "	35-37		

FOOD REQUIREMENT OF INFANTS AND YOUNG CHILDREN

Age	Height Inches	Weight Pounds	Calories
0	20.6	7.5	225
2 months	22.5	10.4	375
4 "	24.5	13.2	500
6 "	26.5	16.0	700
8 "	27.5	17.7	750
10 "	28.5	19.3	775
1 year	29.5	21.0	850
1½ years	32.0	24.5	1000
2 "	34.0	27.0	1075
2½ "	36.0	30.0	1200
3 "	37.5	32.5	1300
3½ "	39.0	34.7	1350
4 "	40.5	37.0	1400
5 "	41.7	41.0	1475
6 "	43.0	45.0	1525
7 "	46.0	49.0	1600

FOOD REQUIREMENT OF CHILDR

BOYS

Age Yrs. Mos.	Height Inches	Weight Pounds	Calories
8—0	48.8	54.5	1700
8—6	49.4	57.1	1750
9—0	50.0	59.6	1800
9—6	51.0	62.5	1850
10—0	51.9	65.4	1900
10—6	52.7	68.0	1950
11—0	53.6	70.7	2000
11—6	54.5	73.8	2050
12—0	55.4	76.9	2100
12—6	56.5	80.8	2150
13—0	57.5	84.8	2200
13—6	58.7	90.0	2250
14—0	60.0	95.2	2300
14—6	61.5	101.3	2350
15—0	62.9	107.4	2400
15—6	63.9	114.2	2450
16—0	64.9	121.0	2500
16—6	65.7	125.5	2550
17—0	66.5	130.0	2600
17—6	67.0	132.6	2650

Age Yrs. Mos.
8—0
8—6
9—0
9—6
10—0
10—6
11—0
11—6
12—0
12—6
13—0
13—6
14—0
14—6
15—0
15—6
16—0
16—6
17—0

FOOD REQUIREMENT OF

MEN

Height Inches	Weight Pounds	Calories
60	120-130	1900-2000
61	122-132	1950-2100
62	124-135	2000-2150
63	127-140	2050-2200
64	131-143	2100-2250
65	134-147	2150-2350
66	138-151	2200-2400
67	142-156	2250-2500
68	146-162	2300-2550
69	150-168	2400-2650
70	154-174	2450-2750
71	159-180	2500-2850
72	165-185	2600-2900
73	170-189	2700-3000
74	176-192	2800-3050
75	181-196	2900-3100

Height Inches
59
60
61
62
63
64
65
66
67
68
69
70

TABLE OF HEIGHTS AND WEIGHTS OF MEN AS PREPARED BY THE ASSOCIATION OF LIFE INSURANCE MEDICAL DIRECTORS*

Ages	15-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
5 ft. 0 in.	120	125	128	131	133	134	134	134	131	130
1 in.	122	126	129	131	134	136	136	136	134	132
2 in.	124	128	131	133	136	138	138	138	137	135
3 in.	127	131	134	136	139	141	141	141	140	140
4 in.	131	135	138	140	143	144	145	145	144	143
5 in.	134	138	141	143	146	147	149	149	148	147
6 in.	138	142	145	147	150	151	153	153	153	151
7 in.	142	147	150	152	155	156	158	158	158	156
8 in.	146	151	154	157	160	161	163	163	163	162
9 in.	150	155	159	162	165	166	167	168	168	168
10 in.	154	159	164	167	170	171	172	173	174	174
11 in.	159	164	169	173	175	177	177	178	180	180
6 ft. 0 in.	165	170	175	179	180	183	182	183	185	185
1 in.	170	177	181	185	186	189	188	189	189	189
2 in.	176	184	188	192	194	196	194	194	192	192
3 in.	181	190	195	200	203	204	201	198	196	196

TABLE OF HEIGHTS AND WEIGHTS OF WOMEN AS PREPARED BY THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK*

Ages	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
4 ft. 11 in.	111	113	115	117	119	122	125	128	128	126
5 ft. 0 in.	113	114	117	119	122	125	128	130	131	129
1 in.	115	116	118	121	124	128	131	133	134	132
2 in.	117	118	120	123	127	132	134	137	137	136
3 in.	120	122	124	127	131	135	138	141	141	140
4 in.	123	125	127	130	134	138	142	145	145	144
5 in.	125	128	131	135	139	143	147	149	149	148
6 in.	128	132	135	139	143	146	151	153	153	152
7 in.	132	135	139	143	147	150	154	157	156	155
8 in.	136	140	143	147	151	155	158	161	161	160
9 in.	140	144	147	151	155	159	163	166	166	165
10 in.	144	147	151	155	159	163	167	170	170	169

* The figures given include the ordinary house clothing. For net weight subtract 4 per cent.

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